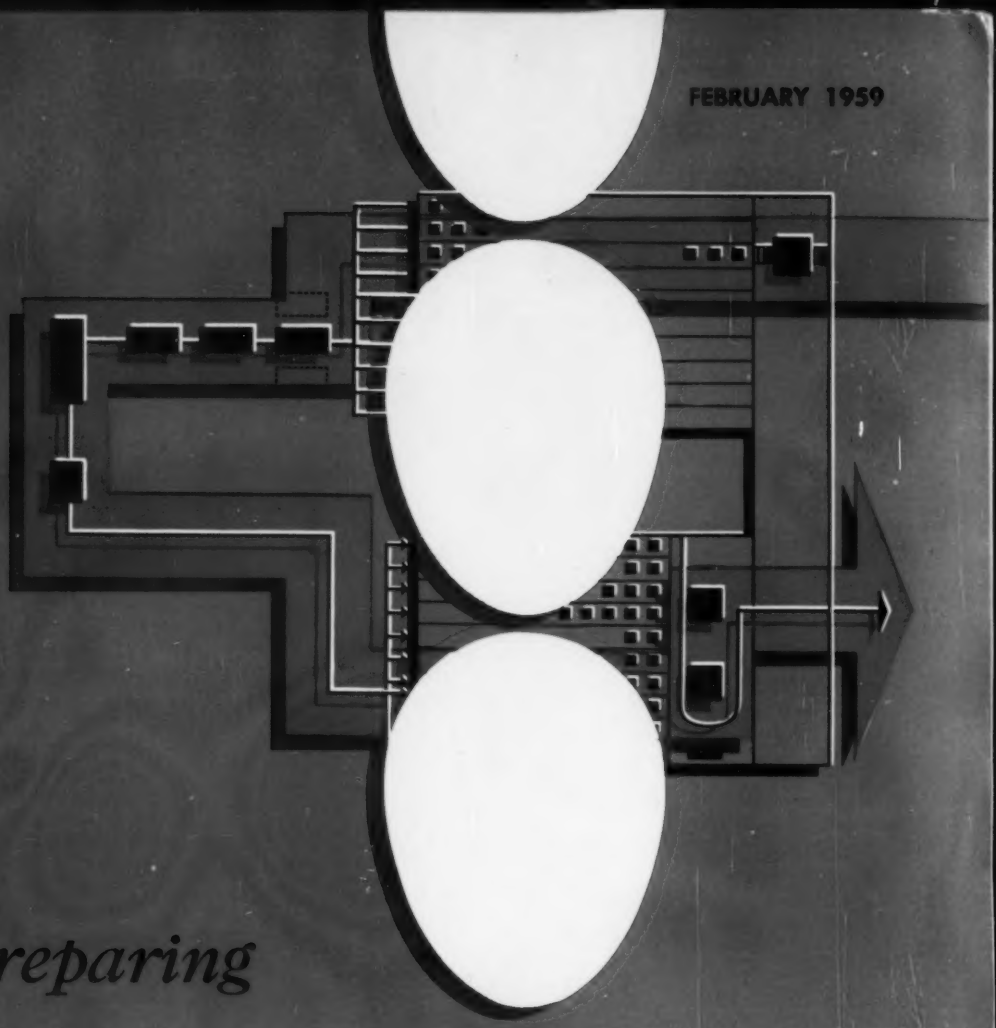
AUTOMATION

FEBRUARY 1959



Preparing Eggs for Market

IN LARGE-SCALE CENTRALIZED PLANT

The Magazine of Automatic Operations

- Creating a Transfer Machine
- Preplanning for Electronic Inventory Control
- AC Adjustable Speed Drive
- Mechanized Stone Cutting

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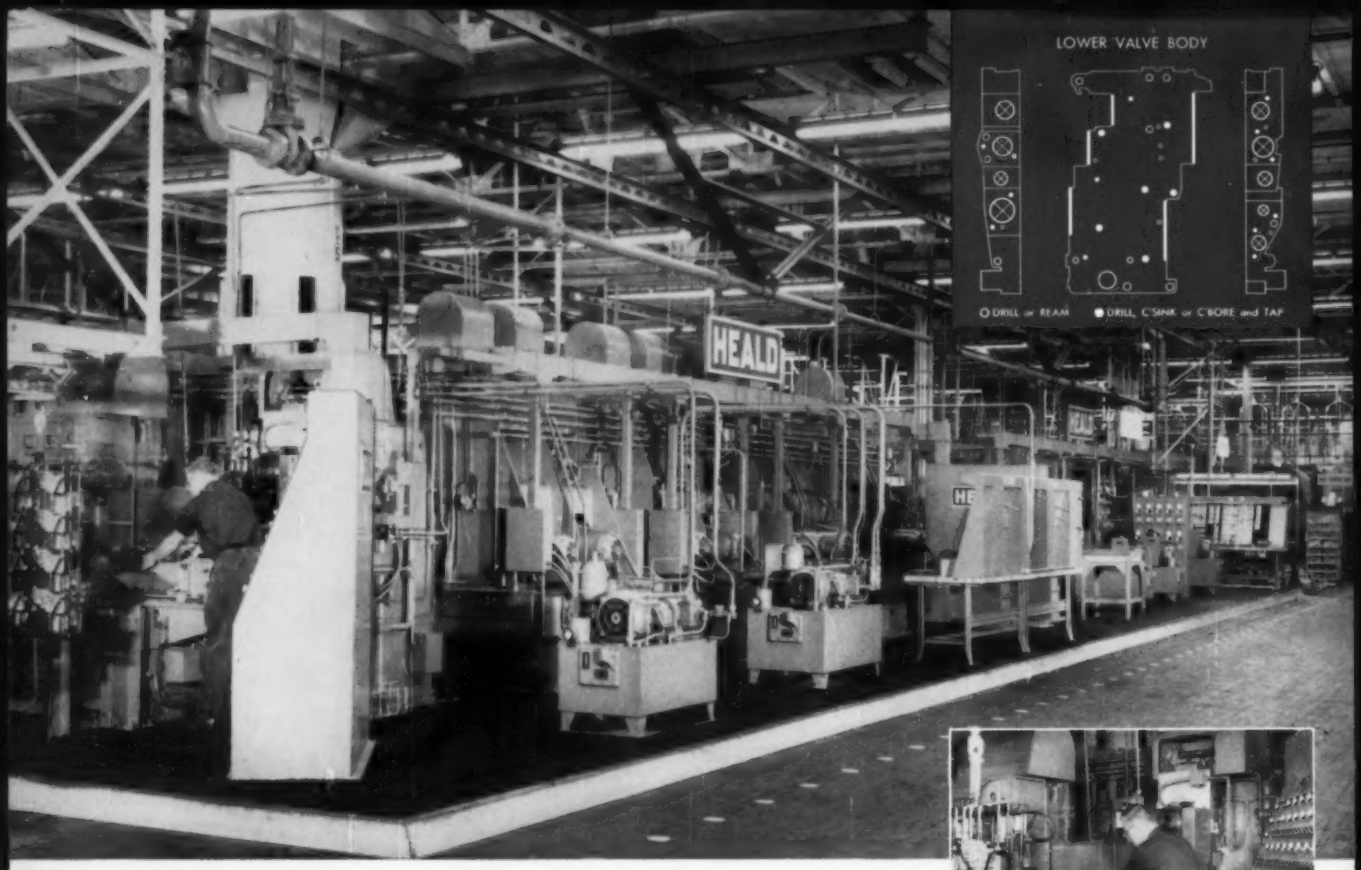


HEALD AUTOMATED LINE performs

171 OPERATIONS

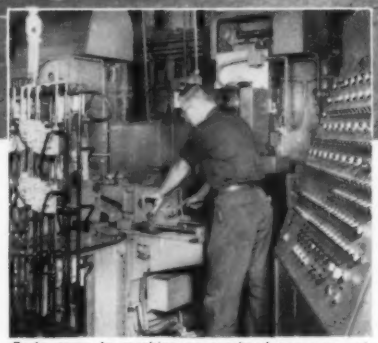
Two identical 39-station Bore-Matic transfer lines drill, bore, ream, tap, face, probe and gage 48 bores and 5 side faces of transmission valve bodies

REPRESENTING the ultimate in straight-line automation, these Heald Model S Bore-Matic transfer lines are speeding the precision production of valve bodies at one of America's leading automotive plants.

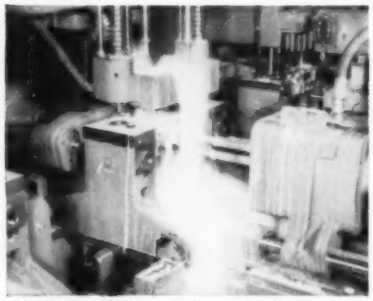
Each line consists of two 50-foot sections — a 19-station section for the small-bore and semi-finish facing operations and a 20-station section for core drilling, reaming and finish facing. A total of 171 operations (112 machining, 52 probing and 7 air gaging) are performed in a fully automatic palletized transfer line with a cycle time of 18 seconds for each station.

Compared to previous methods, the new Heald system results in less handling and locating of parts, fewer rejects, greater efficiency and substantially lower production costs.

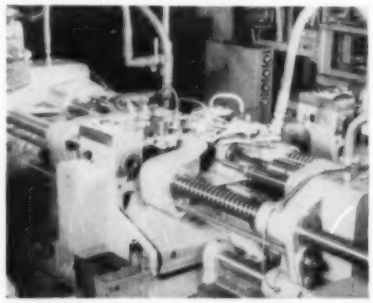
For complete information on this interesting installation, send for a copy of the February 1959 issue of The Heald Herald.



Parts come to machine on overhead conveyor and are semi-automatically loaded onto the transfer pallets. Push button control console for all stations is shown at right.



Tapping and drilling operation at Station 12 of Section 1. Probing station is shown in the background.



Core drilling of spool bores at Station 4 of Section 2. Bores are then semi-finish and finish reamed and air gaged for diameter.

HEALD

IT PAYS TO COME TO HEALD!

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

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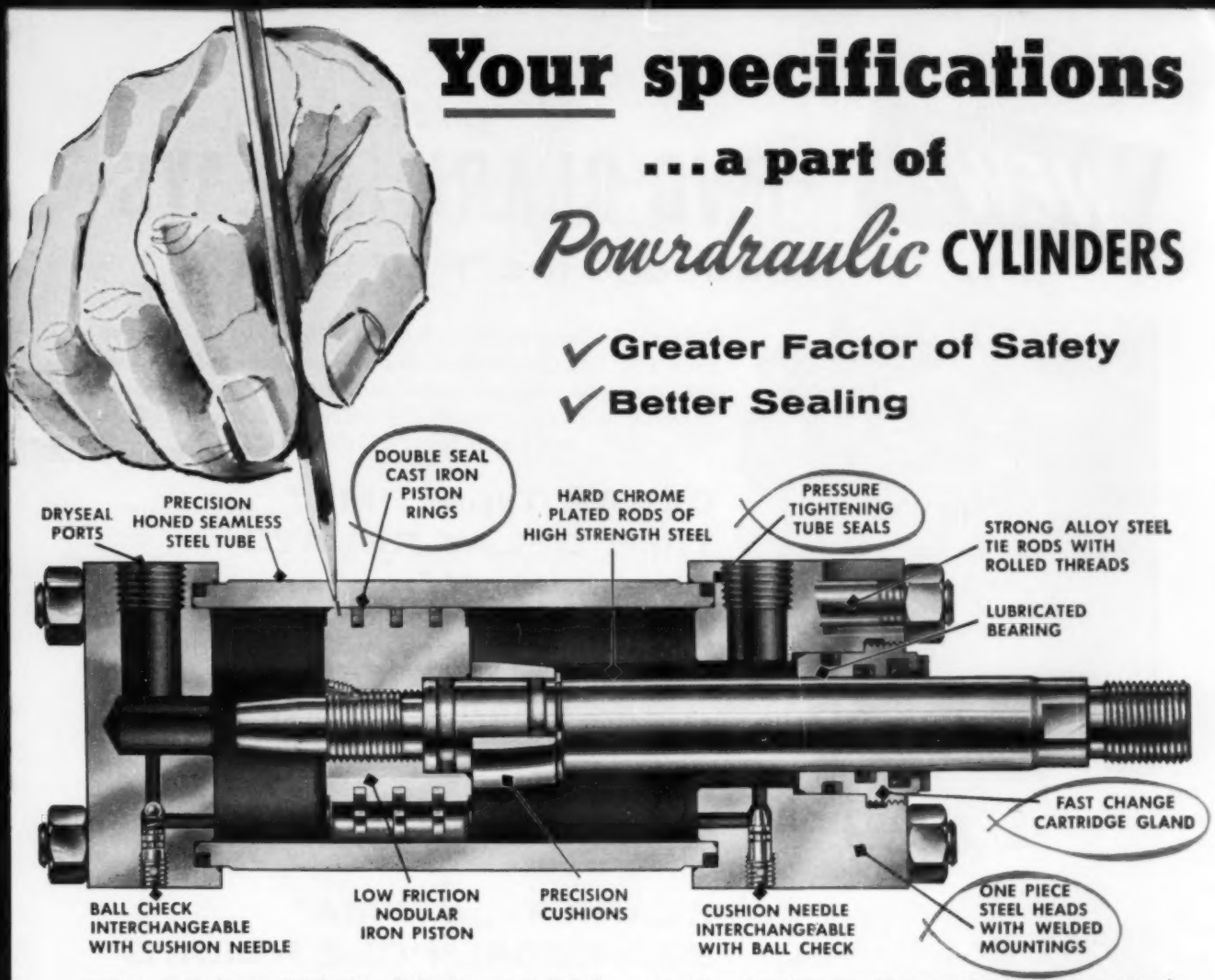
✓Better Sealing


DRYSEAL PORTS
PRECISION HONED SEAMLESS STEEL TUBE
DOUBLE SEAL CAST IRON PISTON RINGS
HARD CHROME PLATED RODS OF HIGH STRENGTH STEEL
PRESSURE TIGHTENING TUBE SEALS
STRONG ALLOY STEEL TIE RODS WITH ROLLED THREADS
LUBRICATED BEARING
FAST CHANGE CARTRIDGE GLAND
ONE PIECE STEEL HEADS WITH WELDED MOUNTINGS
CUSHION NEEDLE INTERCHANGEABLE WITH BALL CHECK
PRECISION CUSHIONS
LOW FRICTION NODULAR IRON PISTON
BALL CHECK INTERCHANGEABLE WITH CUSHION NEEDLE

HANNA Powrdraulic Hydraulic Cylinders meet J. I. C. recommendations and have industry standard mounting dimensions—2000 psi and 3000 psi non-shock. 1½" through 8" bores.

EXCLUSIVE PRESSURE TIGHTENING TUBE SEALS, located on the outside diameter of the cylinder tube, form a positive seal at all pressures from zero to maximum. Minute expansion of the tube due to pressure, squeezes the "O" ring making the seal even tighter. The "O" ring is fully confined between the head and the tube and will not extrude at high pressures. Unlike other cylinders that seal at the tube ends or inside diameter, the Hanna Powrdraulic Cylinder with pressure tightening O.D. seals will remain tight at all pressures.

DOUBLE SEAL PISTON RINGS give you twice the sealing power of conventional piston rings. These bi-directional, cast iron rings, consisting of a ring within a ring, seal both the "in" stroke and the "out" stroke of the cylinder. The piston with double seal rings is packed for life and never should need replacement. You may also choose the optional piston with "U" type synthetic packings.

FAST CHANGE CARTRIDGE GLAND equipped with a leak proof, low friction rod seal forms a tight seal from zero to maximum pressure. Built in rod wiper removes dirt and particles from piston rod as the rod moves "in" and serves as another hydraulic seal to wipe the rod dry on the "out" stroke. You can select either the standard gland or the optional, multiple lip, spring loaded seal. The optional gland is interchangeable and is available with synthetic rubber or Teflon* Vee packing.

ONE PIECE STEEL HEADS WITH WELDED MOUNTINGS are much stronger than conventional bolted construction and assure squareness of mountings. All mountings are designed to carry maximum cylinder loads with a generous safety margin.

Write for Catalog 900 and the name of your nearest representative.

*DuPont's registered trademark.

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES

1751 Elston Avenue Chicago 22, Illinois

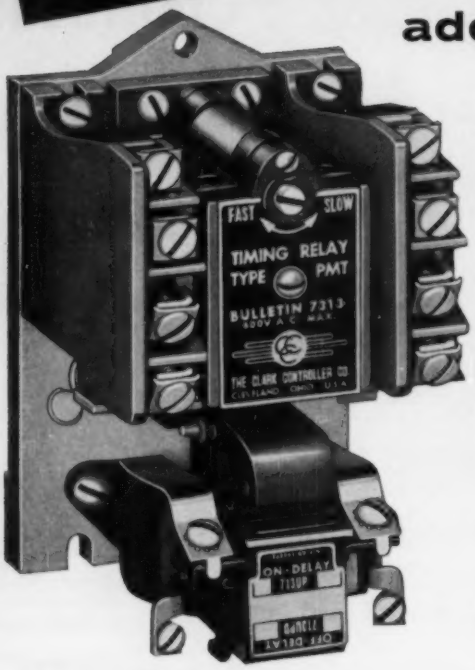
Circle 654 on Page 147

NEW!

SPACE-SAVING

TWO CLARK RELAYS

added to the "PM" Line!...



With the addition of *Time-Delay* and *Universal Pole* Relays to its "PM" line, Clark now offers *the most complete integrated line of control relays available today!* They have the same "modular" design and match physically the Convertible Pole (Type "PM") and Latch Relay (Type "PMA").

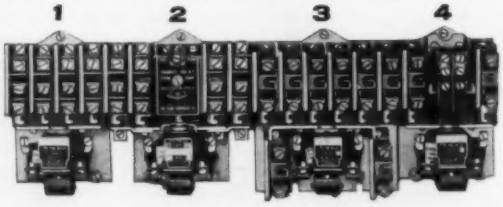
CLARK Type "PMT" TIME DELAY RELAYS

- Line up with other relays in the "PM" line.
- Timing head occupies space of 2 poles above magnet.
- Poles are "universal" type—each with 2 isolated contacts, one normally open, one normally closed, same as used on "PMA" relays described below.
- Available for "ON-DELAY" or "OFF-DELAY" operation (time delay after energization or de-energization). Easily convertible in the field.
- Timed and instantaneous poles are identical.
- Models available with either 2 or 4 timed contacts and up to 6 instantaneous contacts.

CLARK Type "PMA" UNIVERSAL POLE RELAYS

- Line up with other relays in the "PM" line.
- Each pole contains 2 isolated contacts—one normally open, one normally closed, with 600v clearance between contacts.
- Individual poles can be removed or replaced without disturbing others. Each pole has its own arcing chamber—any short circuit is confined to one pole.
- Poles are interchangeable with convertible poles of "PM" relays.
- Models available with up to 14 contacts per relay.

How Clark Relays line up to save panel space.
1. Universal Pole Relay
2. Time Delay Relay
3. Convertible Pole Relay
4. Latch Relay



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FEBRUARY 1959
Vol. 6 — No. 2

AUTOMATION®

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automation outlook

HOW MUCH CONTROL?

". . . size and type of operation, and business requirements, usually establish the degree of automatic control that can profitably be applied in a given bulk material handling installation. In cases where accurate weight control and recording are required, electronic control means are often the economical choice, and may be the only feasible way of providing the requisite system performance. . ."—*James W. Krebs, Gilmore Industries Inc., see page 67.*

FIRST STEP TOWARD EDP

". . . corporate executives who are considering the installation of an electronic data processor should make a thorough investigation of all of the possible uses to which the equipment might be put in order to satisfy themselves that there will be either a definite improvement in operation, greater accuracy, greater speed, a decrease in expense, or a combination of these advantages. . ."—*Alfred James, senior methods engineer, Teleregister Corp., see page 70.*

HOW TO SELL MACHINES

". . . makers of production equipment, including machine tool builders, must develop new models and new methods that are so effective that . . . metalworking manufacturers simply can no longer afford to run their old machines, and must of necessity get the new ones . . ."—*Alfred V. Bodine, president, National Machine Tool Builders' Association.*

PLANNED PREVENTIVE MAINTENANCE

". . . in 1950, a survey showed that American industry spent $8½ billion on maintenance, and that does not include lost production, machine downtime, and the resulting idle labor time. Today, with much more equipment in operation . . . we can add a few more billion dollars in maintenance cost to that 1950 figure. It is estimated that industry will spend $22 billion for maintenance in 1965 . . . Maintenance without preventive measures is costly, especially when the indirect costs are added to actual repairs and replacements. But a well planned and closely followed program of preventive maintenance is a money-making proposition. . ."—*George C. Bonnell, service mgr., Machinery Hydraulics Div., Vickers, Inc.*

MORE INPUT DATA REQUIRED

". . . today, an instrument system that simply measures and controls temperature, pressure, and flow is wholly inadequate for a plant that expects to take full advantage of the economies and quality improvements possible with electronic computer control. Computers . . . are only as good as the information fed to them. Unless instruments capable of detecting quality variations in feed stock, intermediate phases in processing, and finished product are constantly providing intelligence to the computer, the results can be quite discouraging. . ."—*Nelson W. Hartz, Technical Products Div., Mine Safety Appliances Co.*

LOPSIDED ENGINEERING

". . . many of the gains we have achieved in production have been lost in materials handling, paperwork, and other nonproduction functions. To bring nonproduction productivity into line, the engineering thinking that Henry Ford applied to the assembly line needs to be extended more deeply and more broadly into the other functions of business. . ."—*Allen Harvey, partner, Dasol Corp.*

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BPA NBP

Circle 656 on Page 147→

...Fluid Power news

REPORT No. 11,101

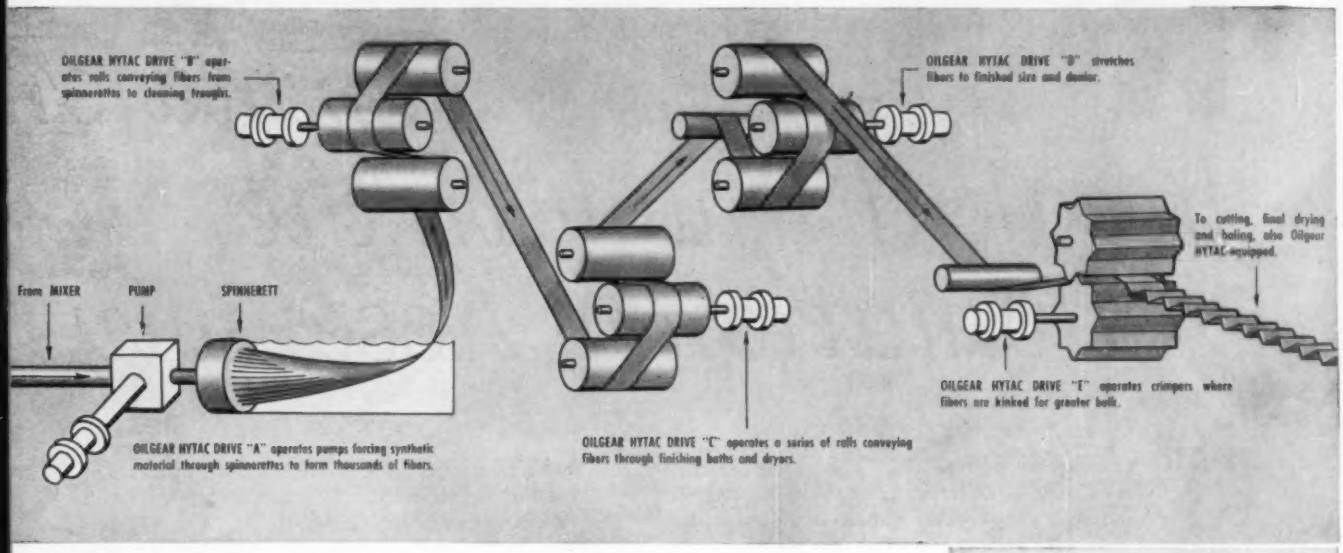
"HYTACS" SOLVE DRIVE PROBLEMS

From Oilgear Application-Engineering Files

HOW OILGEAR "HYTAC" DRIVES SYNCHRONIZE PROCESSING OF NEW SYNTHETIC FIBERS

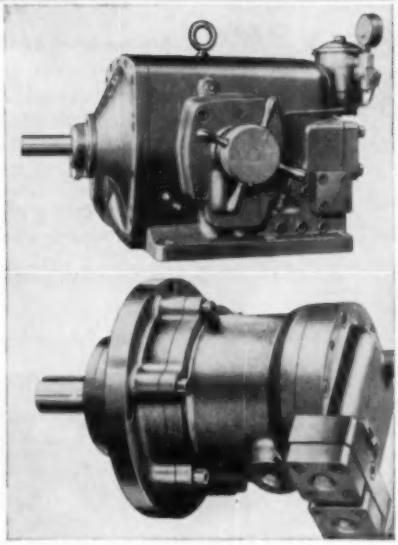
CUSTOMER: *A Producer of Synthetic Fiber (name withheld)*

DATA: Rotary machine drives for complete processing of a new synthetic fiber. User wishes to eliminate line shaft drive, and mechanical, variable speed drive components used in pilot plant due to limited, inaccurate speeds, slow speed changes, difficulty of synchronization. REQUIREMENTS: higher speeds and greater speed range; rapid speed changes; smooth, positive, accurate speed control and synchronization regardless of load variation down to ½ rpm; serviceable by non-technical personnel; safe for use in hazardous atmospheres; occupy minimum space; individual drive flexibility—for addition, removal, or separate operation; keep electrical power requirements to a minimum.


OILGEAR HYTAC DRIVE "B" operates rolls conveying fibers from spinnerettes to cleaning troughs.
OILGEAR HYTAC DRIVE "D" stretches fibers to finished size and denier.
To cutting, final drying and baling, also Oilgear HYTAC-equipped.
From MIXER
PUMP
SPINNERETT
OILGEAR HYTAC DRIVE "E" operates crimpers where fibers are kinked for greater bulk.
OILGEAR HYTAC DRIVE "A" operates pumps forcing synthetic material through spinnerettes to form thousands of fibers.
OILGEAR HYTAC DRIVE "C" operates a series of rolls conveying fibers through finishing baths and dryers.

SOLUTION: Oilgear "HYTAC" (hydraulic tachometer) "ANY-SPEED" drives are shown above as A, B, C, D, E, for each machine. After completion of the first installation by Oilgear personnel, user plant personnel installed, started, and adjusted the drives on the balance of the machines. Drives operate at different speeds during fiber processing, yet hold a pre-selected speed within ±0.5% regardless of load variation. Drive "D" is most critical, as any speed variation here results in changes in fiber diameter, wrong denier, and breakage. These Oilgear systems are completely sealed, flood-lubricated, and can be remotely controlled. USER REPORTS—dependable, continuous, full-load operation for weeks within pre-selected speed control limits; more than adequate speed and speed range with instant speed changes when required; no lag when starting several sections; electrical power consumption far below initial estimates; little reported maintenance in several years of continuous operation. Due to this outstanding performance record, this plant is 100% Oilgear-equipped—hundreds of Oilgear drive components are used.

For similar practical solutions to YOUR *linear or rotary drive problems, call the factory-trained Oilgear application-engineer in your vicinity. Or write, stating your specific requirements, directly to . . .*



Oilgear type "DR-2011" variable delivery (input drive) pump with hydraulic control supplies power to . . .

. . . an Oilgear type "H-2011" constant displacement (output drive) motors. Oilgear "HYTAC" precision, "Any-Speed" drives are available in 1 to 100 hp sizes.

Synchronization of multiple, tandem operations; combining separate operations to handle webs soft and fragile at one point—strong at another; or continuous webs where tension affects quality . . . all need more than conventional drives and controls . . . .
. . . they need Oilgear "HYTAC" precision, "Any-Speed" drives and controls.

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

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Circle 656 on Page 147→

PRODUCTION AUTOMATED RIVETING *a major break-through in the Automation of Assembly*

PAR ... **Originated by TRS** with the invaluable collaboration of some of industry's top production engineers who sought a major break-through in the automation of assembly operations to reduce costs.

PAR ... **A name given by TRS to its Production Automated Riveting process** . . . continuously developed and perfected for 3 years. Proved successful in some of industry's most efficient plants. Now, TRS has sufficient engineers especially trained in the PAR process to serve all manufacturers.

PAR ... **It makes riveting practically a new fastening method through efficiently integrated and automatic . . .**

1. FEEDING of tubular rivets or related products.
2. TRANSFER of parts between riveter stations by means of sliding or rotating fixtures or dial tables. Or through synchronization with conveyors.
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4. CONTROL of setting force as required by parts thickness or material characteristics.
5. SENSING of improper conditions and stopping equipment to avoid injury to parts, equipment or operator.
6. EJECTION of parts as required.

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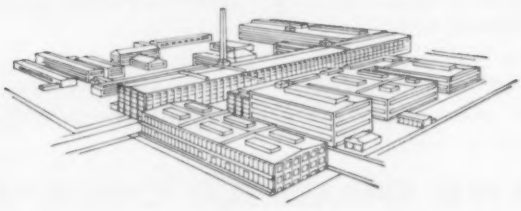
TUBULAR RIVET & STUD COMPANY

QUINCY 70, MASS.



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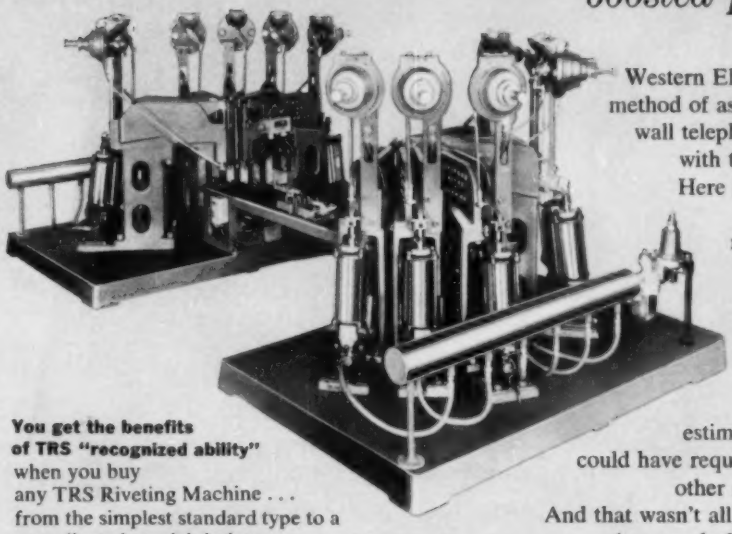
than conventional drives and controls . . . .
. . . they need Oilgear "HYTAC" precision, "Any-Speed" drives and controls.

WESTERN ELECTRIC

boosted production rate 80%



Western Electric engineers sought the lowest cost method of assembling the many components of the wall telephone baseplate. TRS engineers worked with them in solving this fastening problem. Here is the specially engineered Multi-Head Riveter that resulted. Ten automatic riveting machines are combined with a specially designed rolling assembly fixture to minimize handling of the five parts of the assembly and, in two fast operations, automatically attach parts to baseplate with ten rivets in a complex pattern. It was estimated that the same assembly operation could have required approximately 35% more labor if other applicable facilities had been installed. And that wasn't all. Later, when production requirements increased, the addition of a second transfer fixture and a second operator boosted the production rate 80%. Western Electric know-how shows in the profitable solution . . . so does TRS ingenuity and experience.

You get the benefits of TRS "recognized ability" when you buy any TRS Riveting Machine . . . from the simplest standard type to a complicated special design.

TRS offers more machines, to more exactly meet your need . . . will lease but likes to sell . . . guarantees performance and sticks by you with all-out service.

PAR . . . It's a TRS Process for very good reasons!

Obviously, there are two critical elements in the PAR Process. Essential is the special and extensive knowledge and experience needed to design an integrated system of standard or multi-head riveters, feeders, transfers and controls for the particular assembly involved. Equally important are superior knowledge and experience in the design, tooling and application of Multi-Head Riveters because these are usually employed.

TRS originated Multi-Head Riveters over three years ago and is the only experienced source of these machines. Further, because this TRS development opened up new possibilities for automating the riveting process, TRS was able to begin three years ago to develop the special experience and application engineers required to fully meet the requirements of the PAR Process.

PAR . . . A New Opportunity to Reduce Direct Labor Charges

With this new help, hundreds of manufacturers . . . large and small . . . can effect substantial savings in direct labor charges, increase production rates, decrease parts spoilage and machine down-time. Look into it now if your product can be riveted, and especially if several rivets are involved.

The yearly amortized cost of the TRS Multi-Head Riveter equipment is low because it will not be obsoleted by changes in product design or production line.

To save more . . . To protect against equipment obsolesence . . . don't buy any Riveting Machines until you investigate the PAR Process

You're not required to use TRS Rivets but you'll be better off if you do

There are no contracts or obligations involved in the PAR Process. However, it is true that the more automatic you make your riveting, the more important it is to use rivets that reduce operating troubles and machine down-time. And, we can give you good, factual reasons why TRS Tubular Rivets are more reliable in essential qualities and uniformity. Ask for the facts . . . judge for yourself.

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Circle 657 on Page 147

Cleveland Speed Variator gives Ford Motor's mold reel conveyor fast, accurate speed adjustment

Positive, infinitely variable speed control is a must on the mold reel conveyor drive installed at Ford Motor Company's Specialty Foundry, Dearborn, Michigan. Efficiently handling the job is this 6K6 Cleveland Speed Variator designed into the conveyor's drive by the builder, C. O. Bartlett & Snow Co.

To lock the Variator setting at any desired conveyor speed, Ford engineers designed a saddle and hasp arrangement which is part of the over-all drive setup.

Ford Motor's Variator provides a continuous speed progression on a full 9:1 range—to meet any variation in conveyor line operations.

Learn today what these rugged Cleveland Speed Variators can do to help improve your particular manufacturing processes. Write for the "Cleveland Variator Story"—it's all contained in our free, illustrated Bulletin K-200.

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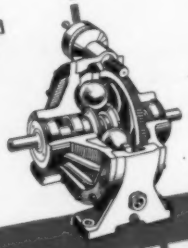


HOW IT WORKS

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, right).

CLEVELAND SPEED VARIATOR

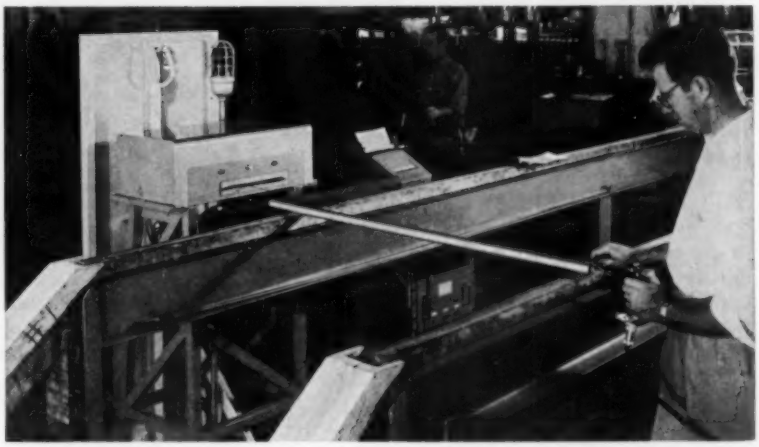
AUTOMATION news

Today's events and developments in the field of automation

System Transmits Shop Data To Office Printout Unit

EFFICIENT transmittal of production data from the shop to the front office is one area of company operations that is apt to be neglected. Although management will judiciously spend large sums for automatic machinery that increases the output and efficiency of a product line, it is prone to overlook the inefficient data handling techniques that connect the production line to the office. Too often, data from automated production lines are collected, recorded, and transmitted through many persons before reaching the final processing point in the office. One method of closing this time-consuming, error-producing, and inefficient loop is to install data handling equipment which records on the production line and reads out in production office.

Pacific Tubing Co. manufactures many types of seamless and welded tubing for industrial use. One of their major problems is accurately measuring individual lengths of tubing for customer invoicing and inventory control. When done manually, four men are required in the data handling loop to measure, record, transmit, and transcribe tube length information between the shop and the office.



OPERATION of the Datex Corp. measuring-recording system at Pacific Tube Co. is relatively simple. As each tube feeds past the encoder unit, an operator pulls out a handgrip attached to a steel measuring cable and places the grip against the end of the tube. By pressing a *Record* button on the grip, tube length is instantly recorded in feet and inches on a data log in the shop office. Encoder unit is mounted on a carriage and can be moved back and forth for centering over the tube by pressing *Right* or *Left* buttons on the grip. A take-up motor maintains the cable under constant tension and automatically reels the cable on a helically grooved drum inside the encoder when the handgrip is released.

CONTROL chassis and Datex-Monroe Data/Log is located in shop office. Output of shop encoder assembly is translated into feet and inches by control chassis upon *Record* signal by measuring operator and printed out by data log.

By installing a linear encoder system developed by Datex Corp., Pacific Tubing has efficiently closed the data handling loop, increased the speed and accuracy of tube measurement, and reduced operational costs. Only one man is required to operate the system which measures the tube lengths on the shop floor and automatically prints out the measurement in feet and inches on a Datex-Monroe Data/Log in the shop office. Although primarily designed to measure tube lengths, the system may be used to size and record any type of linear length—from zero to 100 feet—in 1-inch increments with an accuracy of plus or minus 0.5 inch. Modifications to the system will permit measurement in other increments such as 1/8, 1/16, or 0.001 inch.

The data handling system consists of three components—a measuring cable assembly or encoder for use in the shop, and a control chassis and a data log printout unit located in the office. The encoder houses a helically grooved drum on which is wound 104 feet of steel cable. Attached to the cable is a handgrip containing control switches for operating the printout unit in the office and for shifting the encoder on a carriage. As cable is pulled out of the encoder for each tube measurement, the aluminum drum revolves ½ turn for each foot of cable unwound. The drum is

AUTOMATION NEWS

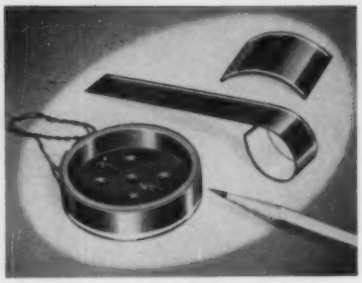
geared to coding device which counts and converts the drum revolutions into feet and inches in the form of a digital coded output.

In the shop office the control chassis stores the digital coded output of the encoder, translates the data into feet and inches, and provides control functions for printout on the data log. The printout unit also contains an accumulator which totals a series of tube measurements when a *Total* button on the side of the data log is pressed.

Flame-Cutting Machine Tracer Unit Follows Pencil Lines

ELECTRONIC TRACER developed by Linde Co. makes it possible to use easily prepared pencil or ink line drawings to control single or multiple torch flame-cutting machines. Known as the Linde Photocell Tracer, the new unit eliminates the need for metal or plastic templates, photographic negatives, or silhouettes as guides for the tracer head.

Drawings of parts to be cut are prepared in the exact size of the part desired. The new tracer incorporates a built-in kerf compensator that automatically makes allowance for kerf width on drawings. After the kerf compensator dial is set for the plate thickness being cut, the photocell tracer automatically follows the drawing outline to produce an exact size duplicate of the outlined part. Tracing speed is controlled by an eddy-current governor which provides stepless speed control ranging from 2 to 30 inches per minute. At average cutting speeds, the tracer can negotiate corners with 1/16-inch radii.



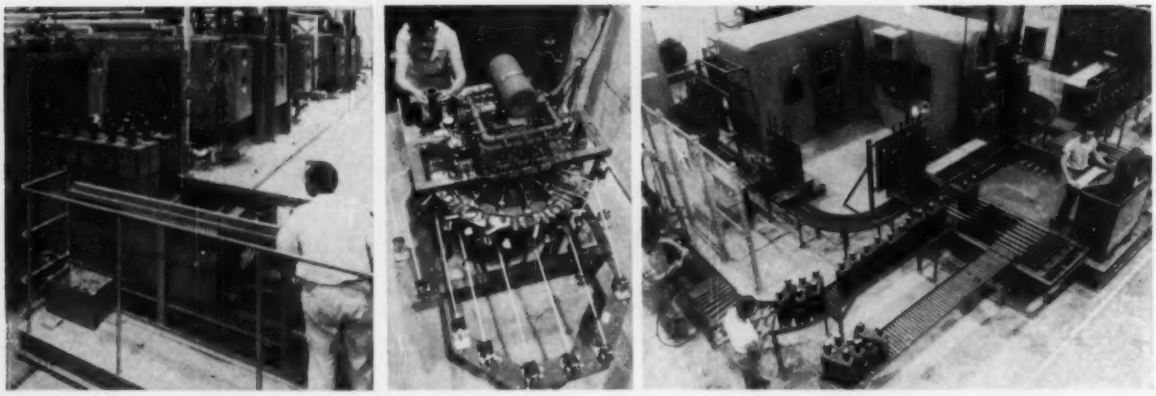
CONTOUR PHOTOCELLS developed by International Rectifier Corp. can be shaped in various forms for use in photoelectric devices for control applications, production flow processes, automatic inspection and sorting, and similar functions. Cell sizes range from a minimum of ¼ x ¼ inch to a maximum of 10 x 10 inches. Units can be custom made to fit any requirement in shapes with as small as 1-inch radius of curvature. Upon exposure to light, the cell generates approximately 0.5 volt.

The tracer unit is not sensitive to extraneous light and will not follow shadows. By connecting different drawings with suitable lines, it is possible for the unit to move from one series of cut shapes to another without interruption, producing "chain" cutting. The tracer also can be operated manually by using a steering knob on top of the unit.

Department Store Plans Large Data Processing System

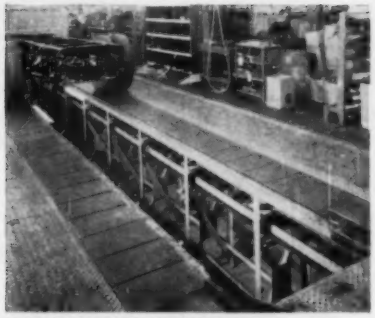
PRELIMINARY work is now under way on a $1 million data processing system at the R. H. Macy & Co. Inc., New York, for the handling of 750,000 customer accounts. Developed by the National Cash Register Co., the electronic system will prepare customer's statements at the rate of 50 a minute—25 times faster than the present speed—and will make it possible for statements to include purchases made within 24 hours of the billing date. The system is not expected to be in operation until 1961.

Included in the installation will be an all-transistor NCR 304 computer and 40 other machines. After a customer makes a purchase or a payment, the information will be recorded on punched paper tape. The data processing system will auto-



FLEXIBILITY combined with automation highlights the new distribution apparatus department plant of Westinghouse Electric Corp. at Bloomington, Ind. Four product lines—power capacitors, fuse cutouts, reclosers and small oil switches, and lightning arresters—are manufactured in the highly conveyorized and partially automated plant. Large ovens are installed for the evacuation and impregnation of capacitors, left picture. Trays of capacitors are moved in and out of the ovens by a hydraulically-operated handling machine that permits one operator to load and unload an oven, or to move a hot load from a preheater to an oven, in 20 minutes. An automatic test and inspection machine, center picture, checks and sorts lightning arrester gap resistance spacers. This 9-station machine checks the spacers for dimensions, high-voltage flashover, and resistance. Depending on resistance value, spacers are distributed to various collecting rods. Output of the machine is 1800 spacers per hour. An 8-station conveyorized capacitor test facility, right picture, performs six automatic tests—capacitance, three separate overpotential tests, recheck of capacitance, and resistance. An overhead conveyor delivers capacitors to a spur conveyor, far right, from which they are fed onto a transfer carriage for delivery to the merry-go-round test conveyor. After test leads are manually attached to the terminals, a punched card reader automatically programs the capacitor through the six tests. A second transfer device automatically unloads the capacitors to either a shipping conveyor or a reject conveyor.

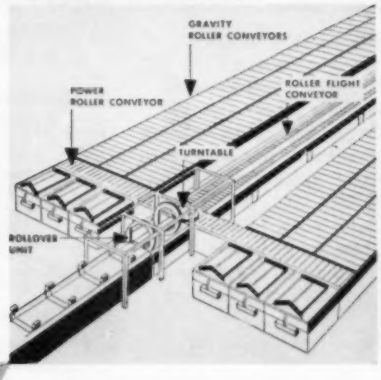
TRUCK ASSEMBLY SYSTEM



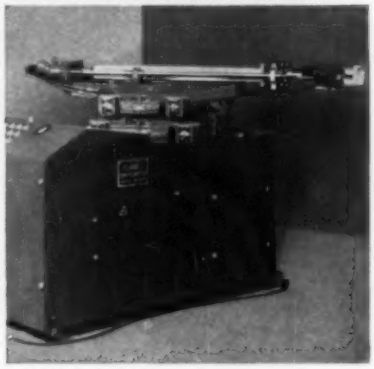
LOG AND CHIP HANDLING SYSTEM

AUTOMATIC SHAKEOUT SYSTEM

ENGINE BLOCK HANDLING SYSTEM



PLANOBOT UNIVERSAL TRANSFER DEVICE



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Circle 659 on Page 147

AUTOMATION NEWS

matically enter the transaction from the tape and subsequently produce the customer's statement. In one hour, the system is capable of handling punched tape containing data from 300,000 sales checks and can process 7 million statements a year in a one-shift operation.

The system is expected to cut record-keeping costs and provide the company with operating information for six Macy stores forming the New York division. The equipment will also have other applications, including automated compilation of merchandising statistics, and will be used eventually for payrolls and accounts payable. Although the data processing system will provide many advantages for R. H. Macy & Co. Inc., the customers may not fully appreciate the progressive step for they will receive their bills at least a week earlier with the new system.

Paper Manufacturing Process To Be Automatically Controlled

CONTRACT for the installation of an electronic/pneumatic instrumentation and automation system at a new Louisiana paper mill of Crown Zellerbach Corp. has been awarded to the Panellit Service Corp. The contract covers design, engineering, and manufacturing of the system, including calibration and start-up services, for a total cost exceeding $500,000.

According to **Albert F. Sperry**, president of Panellit, the system will place the paper manufacturing process under automatic control. Over 100 feet of panels will be used to control the steam plant, Fourdrinier paper machine, super calenders, stock preparation area, clay coating, mix plant, screening and bleaching area, and grinder. Also included in the installation are control of a water supply and treatment plant.

The mill will manufacture paper from southern hardwood and imported chemical pulp. Rated capacity of the mill will be 300 tons per day of coated book paper. Included in the installation will be

Third Conference On Manufacturing Automation

Monday, Tuesday, and Wednesday
March 23, 24 and 25, 1959
Purdue University, Lafayette, Indiana

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THE CONFERENCE: The Third Conference is designed for production executives, manufacturing engineers, and administrative managers who plan, design, and install automated systems for industry. This Conference has been arranged mainly around the basic interests and questions that were developed in Conferences of 1956 and 1957. Four main areas of automation technology will be covered, namely, Organization and Costs, The Process, Handling in Process, and Control of Operations. The key topics to be discussed under each area have been selected for their appeal and practical value.

• • •

THE SPEAKERS: Top authorities from diversified industries will present a carefully integrated series of papers designed to further develop some of the fundamental considerations and basic "how-to" techniques for engineering automated machines, lines, and plants. From various backgrounds and wide experience in applying practical working automation, these men represent an outstanding wealth of knowledge in automatic operations. You will have an opportunity of meeting and talking with these men at the Discussion Meetings.

• • •

THE DISCUSSION MEETINGS: Following all sessions except the first will be a regular period devoted to off-the-record discussion meetings. Because this idea was so enthusiastically received at the 1957 Conference, it is being continued in a slightly modified version at the 1959 Conference. The meetings will be conducted by the various speakers at the conference, and each speaker will discuss topics and questions of direct interest to the conferees. Pertinent questions pertaining to all phases of automation are invited. Be sure not to miss this opportunity to speak your mind or to gather needed information.

MONDAY PROGRAM . . . MARCH 23, 1959

ORGANIZATION AND COSTS

SESSION I

Welcome and Orientation
H. L. SOLBERG, Head, Mechanical Engineering and Associate Dean of Engineering

Developing Automation for Flexibility of Output
A PANEL—Manufacturing Engineering—IBM, Endicott, N. Y.
1. **Organization:** **KEITH BENNETT**, Project Engineer, Test Equipment Engineering
2. **Study of Operations:** **GEORGE PHILLIP**, Project Engineer, Manufacturing Research
3. **Developing the Hardware:** **ALFRED JOHNSON**, Project Engineer, Manufacturing Research
4. **Data Processing:** **WILLIAM ANDRUS**, Manager of Applied Computation
5. **Economics:** **RICHARD SEILER**, Technical Ass't to Ass't Manufacturing Engineer

Buffet Lunch

Pioneering in Automation
WILLIAM ALDEN, President, Automation Management Inc.

SESSION II

Industrial Engineering's Role in Automating Processes
H. H. YOUNG, Assoc. Prof., Industrial Engineering, Purdue University
Where does the industrial engineer fit into the automation picture? Have automation demands influenced his role of after-the-fact evaluation with the basic requirements of before-the-fact engineering of operations to be automated?

Cost Analysis and Machine Replacement
ROBERT A. LOWE, Managing Partner, R. A. Lowe & Co.
How have automatic processes changed the cost analysis picture? For realistic cost figures a whole new approach is necessary. Here the changing techniques are outlined along with specifics on evaluating machinery replacement and acquisition.

Discussion Meetings

Evening

Demonstration and Machine Shops
Chairman: **O. D. LASCOE**, Prof., Industrial Engineering

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AUTOMATION

a new manufacturing feature which will coat the paper during the machine run and eliminate a second handling of the large paper rolls.

Machine Packs Paint Cans Into End-Loaded Containers

PACKAGING MACHINE designed to load paint cans into end-loading corrugated cases has been developed by J. L. Ferguson Co. for an eastern plant of a nationally-known paint manufacturer. The versatile machine is easily converted to pack either pint, quart, or gallon size cans into shipping containers of three different sizes.

Requiring only one operator to fill a magazine with knocked-down containers, the automatic packaging machine performs the following operations: 1. Feeds knocked-down containers into a mechanical case-forming mechanism. 2. Positions formed containers to accept paint cans with wire bails attached. 3. Orients paint cans so that their wire bails cannot damage paint labels during shipment. 4. End-loads the bail oriented cans into the containers with a collect-plunge-and-transfer cycle. 5. Closes and seals the end of the container. 6. Mechanically turns the container so that it travels lengthwise on a conveyor for imprinting, shipment, or storage.

Although originally designed for the paint industry, applications of this machine are readily adapted to handle a wide range of cans used in the chemical, petroleum, and allied fields. By using end-loading style cases, savings in paperboard costs can run as high as 28 per cent.

Automatic Loading-Unloading Machine Dries Wet Grain

GRAIN DRYING machine that automatically controls the flow of wet grain from storage, dries the grain to a desired moisture content, and returns the grain to dry storage has been introduced by the American Farm Equipment Co. All operations are controlled by a General Electric Co. packaged control system mounted on the machine unit.

TUESDAY PROGRAM . . . MARCH 24, 1959

THE PROCESS

SESSION III

Manufacturing Engineering and Machine Procurement

ARMIN FRANK, Manager-Manufacturing, Vacuum Cleaner Dept., General Electric Co.

Proper climate must be established to make the techniques of manufacturing engineering effective. What are the significant steps required in manufacturing engineering analysis for automation? What are the basic considerations in procuring suitable machinery to accomplish the ends desired?

Assembling Complex Devices

GEORGE WEISER, Chief Process Engineer, Delco-Remy Div., General Motors Corp.

Most large-scale automation jobs present formidable engineering problems but these are overshadowed by those created in automating the assembly of small electromechanical devices. This series of case histories shows how some of these difficulties can be overcome.

Discussion Meetings

Buffet Lunch

Automation on the Farm

E. W. LEHMANN, Prof. Emeritus, Agricultural Engineering, University of Illinois

HANDLING IN PROCESS

SESSION IV

Handling as the Key to Automation for the Small Company

JAMES R. SEBASTIAN, President, The Rapids-Standard Co. Inc.

Mechanized handling in many of the basic supporting operations in the smaller company provides real dollar savings. Although production quantities are modest and variety high, a program tailored to the problem can be extremely effective.

Handling Products for Distribution

ALLEN HARVEY, President, Dasol Corp.

What is the basic philosophy behind successful automation in distribution? A system approach can show the way to unprecedented achievements in lower costs and increased efficiency.

Discussion Meetings

Banquet

Guaranteed Annual Automation

LEON GREENBERG, Chief of Div. of Productivity and Technological Developments, Bureau of Labor Statistics, U. S. Dept. of Labor

WEDNESDAY PROGRAM . . . MARCH 25, 1959

CONTROL OF OPERATIONS

SESSION V

Modern Developments in Control

DR. JOSEPH F. MANILDI, General Manager, Thompson-Ramo-Wooldridge Products Co.

Up to now there has been considerable talk about computers on the production line but little application. With intensive research, the first stages of application are now being made. What has been learned? Can we know enough about processes themselves to use computer control? What does the future promise?

Numerical Control of Production Machines

W. E. BRAINARD, Chief Engineer, Servo Machine Tool Div., Kearney & Trecker Corp.

The most important development in production machinery in 50 years, numerical control is now off to a flying start. Systems in use number in the hundreds. What are the attributes of a good practical system? What advantages are possible for small and variety-lot production? What dollar savings are possible?

Discussion Meetings

Buffet Lunch

Automating the Horses

O. C. LEVY, Vice President, American Totalisator Co., Div. of Universal Control Inc.

SESSION VI

An Institute for Manufacturing Engineers?

Chairman: **R. W. BOLZ**, Editor

Modern automation technology calls for high-level engineering of the manufacturing system. Automation in manufacturing industries has become the responsibility of the manufacturing engineering function. Some means for spotlighting the needs and the interests of this professional group is desirable—a means providing a common meeting place to exchange ideas. Is a society the answer?

• • •

INFORMATION: Printed copies of the program are available by writing: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio, or by mailing the Inquiry Card on Page 147. Conference Registration and Room Reservation may be completed by mailing the coupons on Page 144. Questions for discussion at the conference should be mailed to: Prof. E. S. Ault, Head, Dept. of Machine Design, Purdue University, Lafayette, Ind.

AUTOMATION NEWS

Wet grain flows by means of gravity or auxiliary conveyor from a storage bin into the dryer's hopper until the grain reaches a predetermined level. At this point a pressure switch stops a loading auger motor and starts a fan and a burner unit for drying the grain. As shrinkage occurs during the drying process, the grain level drops below the pressure switch, automatically stopping the fan and burner. At the same time, the loading auger starts refilling the hopper until the predetermined level is again reached. The pressure switch again starts the fan and burner units to continue the drying cycle. Reloading for shrinkage may occur several times during the drying of high moisture content grain.

When the grain is dried to the desired moisture content, the burner unit automatically stops while the fan unit continues to operate for cooling purposes. Once the grain is cooled, the fan stops and an unload auger motor begins moving the dried grain from the dryer to a dry storage bin. When the dryer is empty, an unloading pressure switch senses the absence of grain, automatically stops the unloading auger motor, and starts the loading auger motor for refilling the dryer. The operation continues until a pressure switch in the wet grain storage bin stops the process when the supply of wet grain is exhausted.

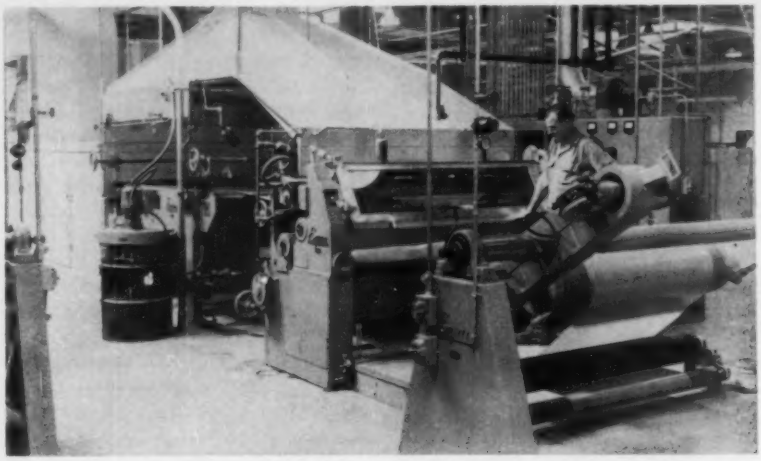
Engineered Package Selection Produces Tangible Savings

STUDY of packaging techniques of over 800 manufacturers representing 18 industrial markets and areas is being conducted by the Better Packaging Advisory Council, a nonprofit organization devoted to improving packaging through market and laboratory research. First area investigated covered the use of fibre cans and tubes as packaging materials.

The survey disclosed that more than 50 per cent of the manufacturers are contemplating a change in package design or material for the coming year. During the last five years, 30 per cent of the companies queried had changed their packaging materials from metal cans, folding or corrugated cartons, or boxes to fibre cans or tubes. Seven major reasons were cited for choosing fibre containers for packaging. These included economy of container, better product protection, economy of shipping, opening and closure convenience, better appearance, durability, and facility of labeling and sealing.

The survey re-affirmed the significance of cost reduction as a major influence in selecting packaging materials and design. Regardless of the industry or market situation, cost reduction savings are a greater source of company profit than are increased sales. For example, if a company's net profit on sales amounts to 10 per cent, a cost reduction of only 10 per cent would be equivalent in profits of a sales increase of 100 per cent. Therefore, cost reduction might produce as much profit as other company operations.

Of the companies surveyed, 74.4 per cent reported a cost reduction in container cost, shipping cost, or filling and sealing cost. Reduction in costs averaged 16.1 per cent in containers, 9.6 per cent in shipping, and 14.9 per cent in filling and sealing. However, the survey showed that many manufacturers neglect to include shipping, filling and sealing, and handling costs when computing package costs. Any accurate estimate of costs must include all the fringe costs which can become fringe savings.

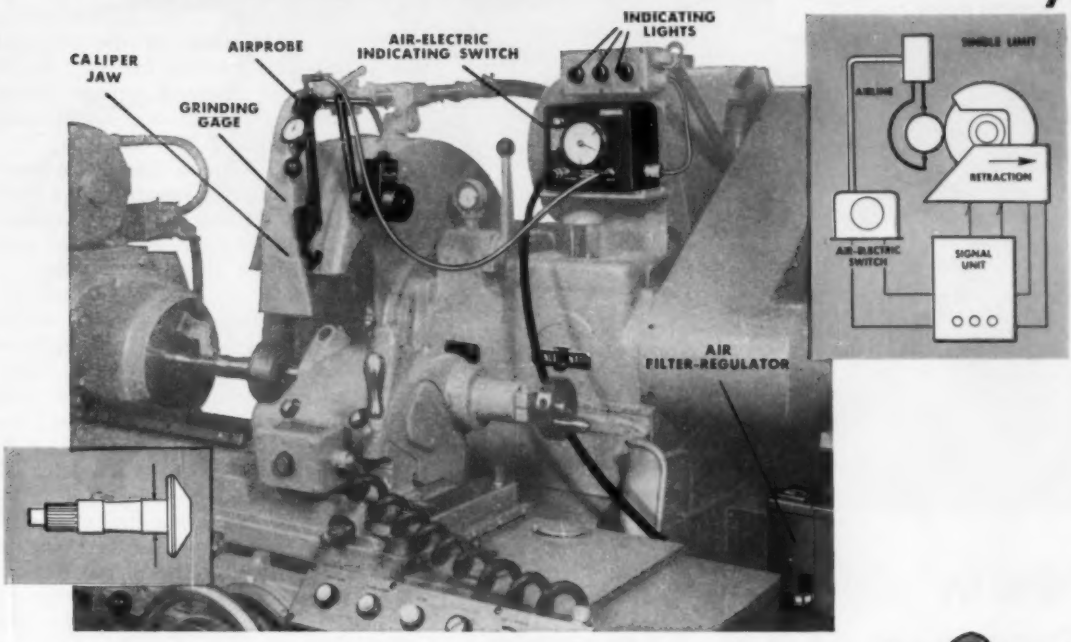


PRESSURE-SENSITIVE tape products are coated on this high speed line built by Frank Egan Co. for a new Chicago plant of Johns-Manville Corp. The coater operates like a printing press, using adhesives instead of inks, and is capable of "printing" an adhesive coat as thin as 0.0003 inch at speeds as high as 40 feet per minute. After the coated material passes through a 40-foot oven, extreme left, it is wound on special take-up equipment. All coating line equipment and motor drives are synchronized at a main control panel to assure efficient operaiton at various speeds.

SPOTLIGHTING PEOPLE

William G. Newton named to the newly created post of corporate industrial engineering manager for Beckman Instruments Inc. . . . **Carl G. Peterson** elected president of Thayer Scale Corp. and Thayer Mfg. Co. . . . **Irvin R. Spangler** appointed sales manager for the machine and tools division of Michigan Tool Co. . . . **James Vrungos** appointed manager of marketing at Electronic Control Systems, Electronics Div., Stromberg-Carlson . . . **James R. Keogh Jr.** named manager of the Philadelphia branch office of Alvey-Ferguson Co. . . . **Louis F. Polk**, vice president and group executive of Bendix Aviation Corp. and president of Sheffield Corp., elected president of the American Ordnance Association . . . **Mitchell P. Kartalia**, manager of the marketing division, elected vice president of Square D Co. . . . **John F. Reed** and **Arland R. Walkley** named vice presidents of Manning, Maxwell & Moore Inc. . . . **Harry E. Gravlin Jr.** joined Hamilton Standard, Div., United Aircraft Corp., as production manager . . . **Leonard Raymond**, chief automotive engineer-research of Socony Mobil Oil Co., elected presi-

MODERNIZE YOUR PLAIN GRINDING . . . *Economically!*



Automatic Control Gaging improves your grinding operation 3 ways . . .

1 It controls on the basis of finish size *only*, thus overcoming the disadvantages of timed cycle or fixed stop grinding. Wheel wear, O.D. variation in work to be ground, "give" in many of the machine elements, and flexing of the work, no longer affect accuracy and piece-to-piece uniformity of the finished part.

2 It controls *automatically*, thus you eliminate any errors caused by operator fatigue, inexperience, or inattention. The Federal automatic control gage never tires, will hold part size to .0001" or better on a good machine, and is easily adjusted to control different sizes of work. Its air-electric system overlooks minor surface irregularities which confuse size readings of other gages.

3 Automatic control gaging makes it possible for one operator to handle two grinders performing the same or different operations. Here's an actual case history of direct labor cost savings:

	MEN	MACHINES	COST PER PIECE	PRODUCTION RATE (pieces per 8 hr. shift)
BEFORE			$.03585	1344
CONTROL GAGING INSTALLED				
AFTER			$.01526	1386

SAVINGS (per piece) . . . . . $.02059
RATE INCREASE (per shift) 42
TOTAL SAVINGS (per shift) $28.59
EQUIPMENT COST AMORTIZED — 60 DAYS

HOW IT WORKS

The Federal automatic control gage measures the work continuously *as metal is being removed* and automatically retracts the wheel the instant finish size is reached.

EASY TO INSTALL

This standardized Automatic Control Gage (Model 133M-103 illustrated) is stocked for speedy delivery. Only a few components to install. Easily applied to any plain grinder having hydraulic wheel slide. Can also be used in connection with wheel slide stop to *additionally* provide spark out.

Federal control gages are also available through machine tool manufacturers for control of either plain or I.D. grinders and are supplied as part of the grinder package. When discussing machine tool requirements, be sure to specify FEDERAL gaging. Federal maintains close engineering alliance with leading machine tool manufacturers. They, too, will be glad to discuss automatic control gaging with you.

For more information, contact the nearest FEDERAL representative or write . . .

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Ask **FEDERAL** *First*

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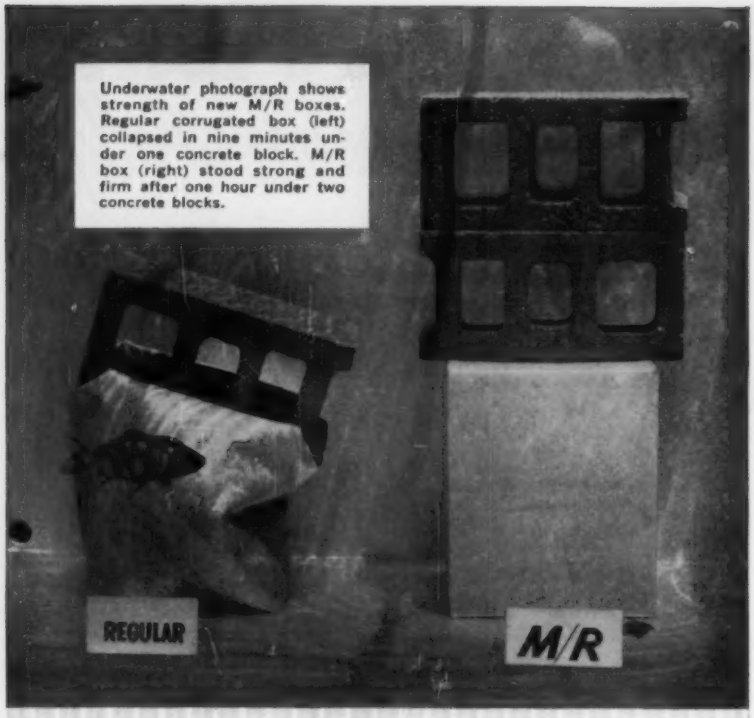
Underwater photograph shows strength of new M/R boxes. Regular corrugated box (left) collapsed in nine minutes under one concrete block. M/R box (right) stood strong and firm after one hour under two concrete blocks.
REGULAR
M/R

New *M/R* Corrugated Boxes

stay strong when wet...even under water!

Important news about Hinde & Dauch's new M/R (moisture resistant) corrugated boxes: Hydrocooler tests show M/R boxes shed water; stay strong and durable for packing and shipping all kinds of wet products. Moreover, M/R boxes stack high and straight. They save packing and handling time, provide remarkable product protection. Initial tests indicate shipping damage to peaches reduced 50%. And the smooth, clean surfaces of new M/R boxes can be colorfully printed with your brand message. H & D Package Engineers are ready to design an M/R corrugated box for your product. Write, wire or phone for complete information today!

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Address_____

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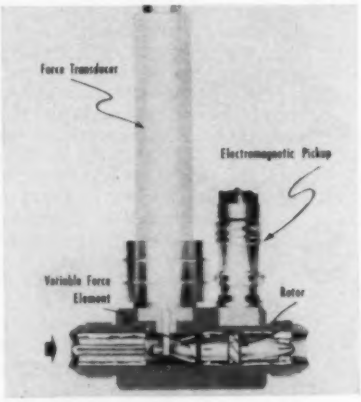
dent of Society of Automotive Engineers . . . **John L. Pfeffer** elected president of Struthers Dunn Inc. . . . **Joseph M. Till** named production control manager for Montebello plant, Western Design, Div., U. S. Industries Inc. . . . **Eugene Caldwell,** general manager of Baker Industrial Trucks, Div., Otis Elevator Co., elected president of the Material Handling Institute Inc. . . . **Frank P. Houpt** appointed manager of the Systems Application Engineering Dept., Fischer & Porter Co. . . . **David A. Thomas** elected vice president and general manager and **Harold M. Emlein** named operations manager of the new Industrial and Automation Div., Radio Corp. of America . . . **Henry S. Black** appointed director of the DataTape Div., Consolidated Electrodynamics Corp. . . . **H. J. Wissemann,** assistant vice president, appointed general manager of the Apparatus Div., Texas Instruments Inc. . . . **Don R. Proctor** named chief engineer of Electronic Engineering Co. . . . **James H. Sands,** executive vice president of Eclipse Fuel Engineering Co., named adviser to the director of the Metalworking Equipment Div., Business and Defense Services Administration, U. S. Dept. of Commerce . . . **Linwood L. Leftwich** ap-



MASS FLOWMETER developed by Fischer & Porter Co. provides high accuracy mass flow rate measurement with a single meter. Unit consists of two hydraulically matched metering components—a variable force element and a volumetric element—in a single meter body. The variable force element produces a voltage proportional to volume flow rate squared times the fluid density. Volumetric element produces a frequency proportional to volume flow rate. By dividing the latter electronically into the former, mass flow rate is calculated. Flowmeter will measure a variety of liquids at flow ranges up to 1 million pounds per hour.

Circle 661 on Page 147

Circle 662 on Page 147→

A-B Reliable Control Units

for every industrial application

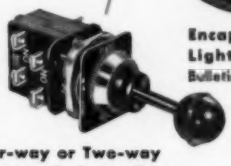
Among the many hundreds of Allen-Bradley push button and control units, you are certain to find the types best suited to your particular needs. The seven units shown below are a few of the latest additions to the Allen-Bradley *quality* line of control units.

All Allen-Bradley control units—standard duty, heavy duty, and oiltight—have double break, silver alloy contacts—to assure reliable operation. Simple constructions and generous wiring room are outstanding features. Insist on Allen-Bradley control units for *all* of your equipment—you can't go wrong!

NEW

Illuminated Push Button. Combines pilot light and push button in one unit. Oiltight Bulletin 800T.

Push-to-Test Pilot Light. Oiltight Bulletin 800T.



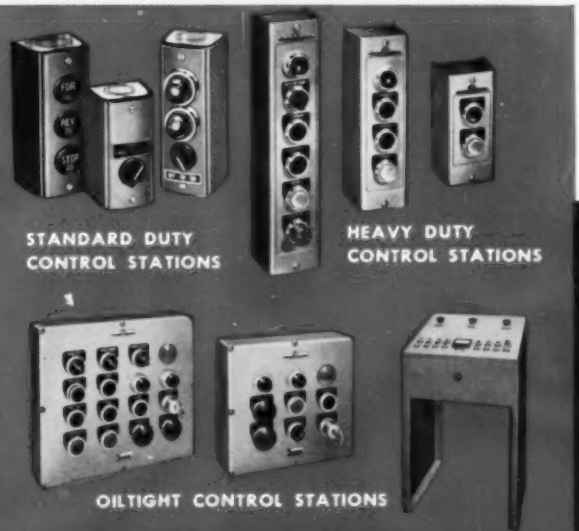
Four-way or Two-way Selector Switch. Oiltight Bulletin 800T.

Encapsulated Pilot Light. Heavy Duty Bulletin 800.

Encapsulated Pilot Light. Oiltight Bulletin 800T.

Time Delay Push Button. Delay is adjustable from 0.5 second to 5 seconds. Oiltight Bulletin 800T.

Double Circuit Push Button. Has 2 N.O. or 2 N.C. contacts. Oiltight Bulletin 800T.



ALLEN-BRADLEY OFFERS the most complete line of standard duty, heavy duty, and oiltight control stations on the market. Send for Publication 6090 today.

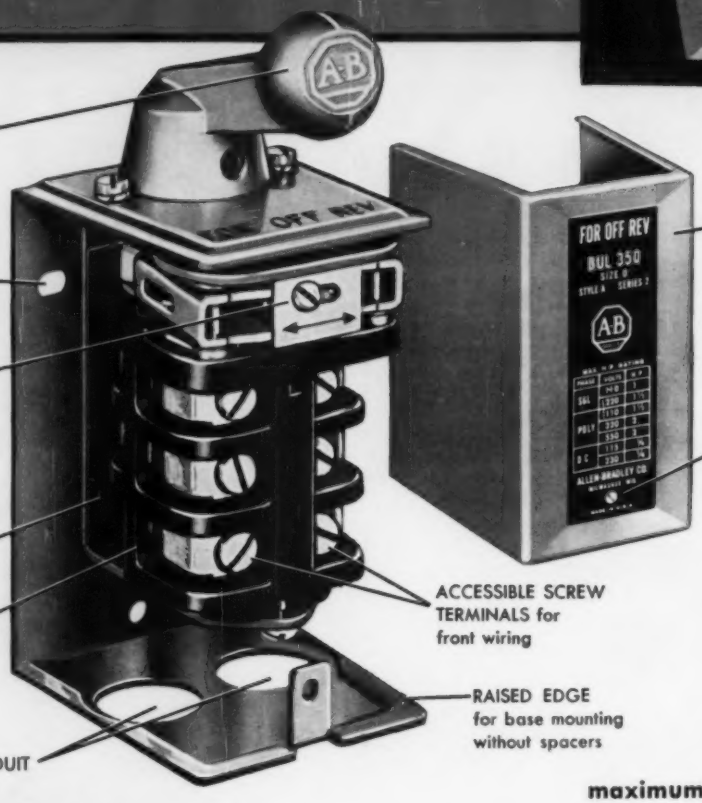
1-59-MR

ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

A new "quality" standard for small REVERSING DRUM SWITCHES

A-B QUALITY



GOOD-LOOKING AND GOOD "FEELING" DIE CAST HANDLE

EASILY ACCESSIBLE MOUNTING HOLES

MERELY LOOSEN SCREW AND SLIDE PLATE to change from momentary to maintained contacts —or vice versa

INDEPENDENT SWITCH MOUNTING prevents misalignment

HEAVY CONTACT SURFACES for long operating life

TWO CONDUIT OPENINGS

WRAP-AROUND COVER gives complete access to drum

SINGLE SCREW COVER MOUNTING —screw cannot fall out

ACCESSIBLE SCREW TERMINALS for front wiring

RAISED EDGE for base mounting without spacers

maximum rating 2 horsepower

NEW OILTIGHT COVER PLATE FOR CAVITY MOUNTING

Bulletin 350 Reversing Switch can be furnished with oiltight cover plate with rubber gasket seal for cavity mounting in a machine base.

This *all-new* Allen-Bradley reversing drum switch was designed to keep pace with the mechanical beauty designed into so many of the modern machine tools.

The Bulletin 350 reversing switch is equivalent to a three-pole, double throw switch . . . and can be used with d-c motors; or single phase, two phase, or three phase a-c motors.

Investigate the Bulletin 350 . . . the *new leader* of its class . . . in appearance, ease of installation, and operating life. An Allen-Bradley *quality* switch . . . in every sense of the word. Send for descriptive bulletin.

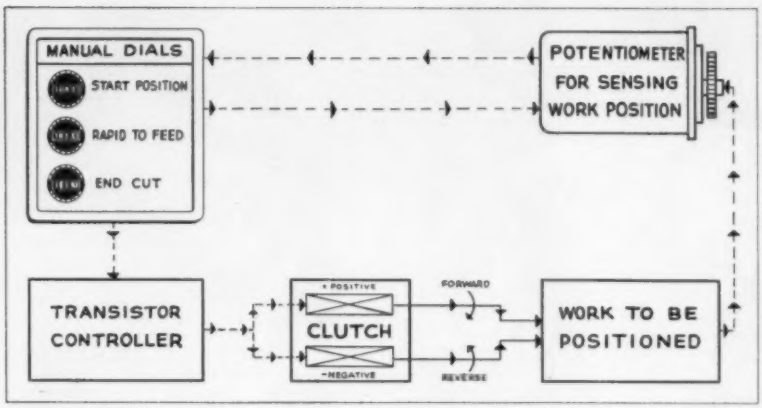
ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

1-59-MR



ELECTROMECHANICAL programming system that permits operators to dial changes in machine setup has been developed by Seneca Falls Machine Co. The system is available as a package and can be applied to machine tools, conveyor systems, and a variety of other work positioning devices that would benefit from remote dial-control. Work position is controlled by automatic comparison of the output voltage of two potentiometers. One is located at the control panel, and its output voltage is determined by a dial setting calibrated in inches of work travel. The second potentiometer is mounted on the work carriage, and its voltage output is a function of actual work position. The difference in voltage between the two potentiometers is sensed, and the work carriage is automatically driven to the null point where carriage position and dial setting correspond. Physical movement of the work carriage is controlled by a clutch that is actuated by voltage phase. Positive phase actuates a forward clutch element, and negative phase actuates a reverse clutch element. When the voltage difference between the two potentiometers reaches zero, the clutch is de-energized, and the carriage stops.

pointed vice president of Feedback Controls Inc.

SPOTLIGHTING PRODUCTS

Electrical contact rivets, cold-headed directly from sintered silver-cadmium oxide wire and in a form compatible with high speed attachment in automatic rivet setting machines, are available from Judson L. Thomson Mfg. Co. . . . **Lightweight pneumatic regulator** for air, helium, or nitrogen is adjustable from 0 to 5000 psi with a constant outlet pressure and is available from Benbow Mfg. Corp. . . . **Capsule-size mercury switch,** weighing only 1.8 grams with leads attached, is available from Micro Switch, Div., Minneapolis-Honeywell Regulator Co. Switch is designed for use in computers, scales, electronic organs, and other devices where a minimum of operating energy is available and space is limited.

SPOTLIGHTING PLANTS

Greenlee Bros. & Co. has purchased the Buss Machine Works and its subsidiary, B & T Machinery Co. This acquisition adds a new line of die casting machines to the Greenlee line of standard and special machine tools. . . . **Stromberg-Carlson-San Diego** has started construction of a new building at its Electronic Systems Plant in San Diego, Calif. The new plant will allow expansion of engineering and manufacturing activities for computer readout and display equipment. . . . **Raytheon Mfg. Co.** has divided its Commercial Equipment Div. into two new commercial product divisions. The Equipment and Systems Div. will concentrate on complete equipment and systems ready for end users. Products will be electronic, electrical, or electromechanical in nature, such as radio telephones, radio direction finders, and industrial precipitators. The Industrial Apparatus Div. will concentrate on building block components that can be used by other manufacturers as integral parts of their products or as production apparatus used in their manufacture. . . . **Texas Instruments Inc.** and **Metals & Controls Corp.** are planning to merge, subject to the approval of the respective stockholders of each firm. Proposed merger plan will be submitted to stockholders of both companies early in 1959. . . . **Barden Corp.** has started production of instrument precision ball bearings in a new 125,000 square foot plant in Danbury, Conn.

Features that set them apart from whatever is "second-best"!

Cutaway view of TRE Male Rod End.

SPHERCO®
SPHERICAL BEARINGS & ROD ENDS

Quality SPHERCO Bearings and Rod Ends are precision built for superior performance. They are available in a wide range of sizes of varying design and materials to meet specific requirements. A SPHERCO engineer in your area will be happy to help you with your problems.

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A PRODUCT OF SEALMASTER BEARING DIVISION STEPHENS-ADAMSON MFG. CO.
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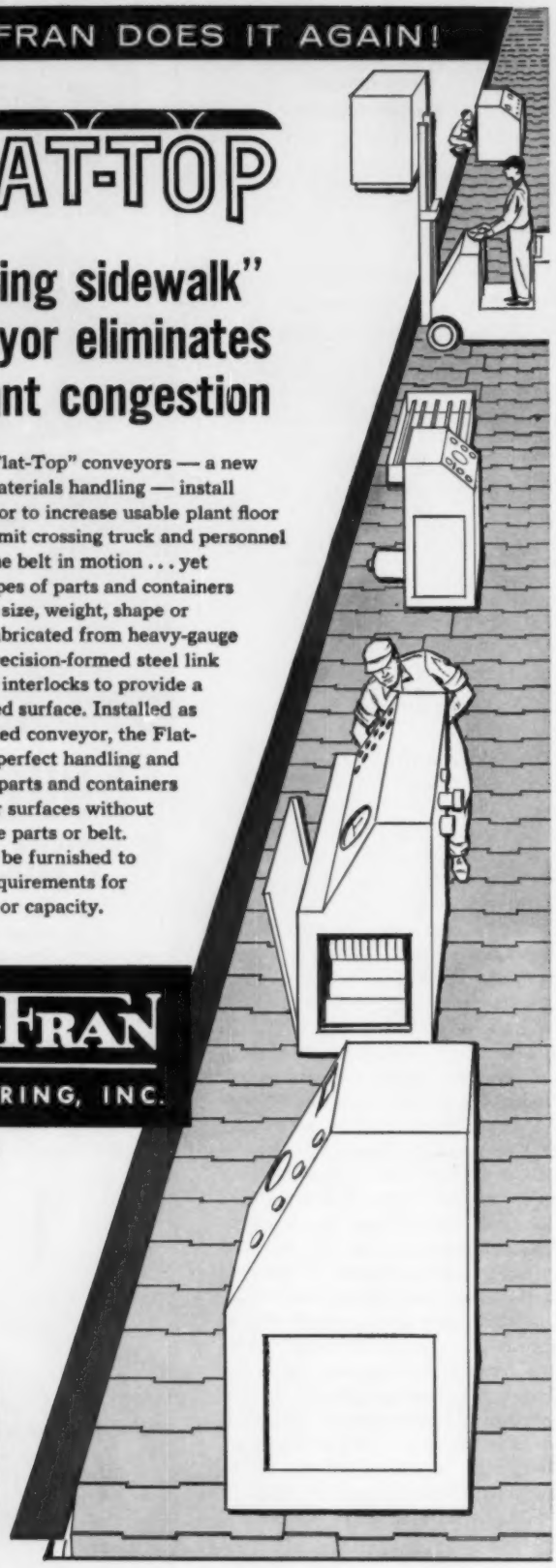
Circle 663 on Page 14

MAY-FRAN DOES IT AGAIN!

FLAT-TOP

"moving sidewalk" conveyor eliminates plant congestion

May-Fran "Flat-Top" conveyors — a new concept in materials handling — install flush-with-floor to increase usable plant floor space . . . permit crossing truck and personnel traffic with the belt in motion . . . yet handle all types of parts and containers regardless of size, weight, shape or condition! Fabricated from heavy-gauge steel, each precision-formed steel link overlaps and interlocks to provide a smooth, sealed surface. Installed as a floor-mounted conveyor, the Flat-Top permits perfect handling and deflection of parts and containers with irregular surfaces without damage to the parts or belt. Flat-Top can be furnished to meet your requirements for width, length or capacity.



MAY-FRAN ENGINEERING, INC.

1761 Clarkstone Road
Cleveland 12, Ohio

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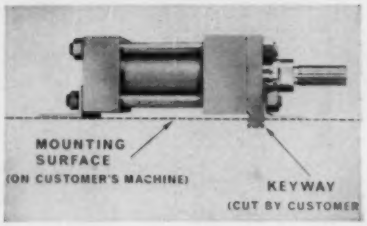


SHEAR KEY cylinder mounting has been adopted as a standard for all surface-mounted, square type cylinders manufactured by Hannifin Co., Div., Parker-Hannifin Corp. Arrangement allows quick, positive alignment of the cylinder in a keyway milled into the mounting surface. Majority of thrust is absorbed by the key rather than by the mounting bolts which is desirable where maximum operating pressures and short stroke cylinders are used. Key thickness on cylinder is machined to close tolerances so that the keyway can be premilled with assurance of an accurate fit.

. . . **International Telephone and Telegraph Corp.** has established the ITT Federal Div. which was formed from two consolidated divisions, the former Federal Telephone and Radio Co. and the former Farnsworth Electronics Co. . . . **Daystrom Inc.** has acquired the business and assets of Industrial Gauges Corp. which will become the Industrial Gauges Dept. of Daystrom-Weston Industrial Div. Primary product lines of Industrial Gauges include x-ray, wire and infrared gages, and refractometers.

MEETINGS AND EVENTS

Feb. 12-13—

Computer and Data Processing in Industry. Conference sponsored by the Dept. of Industrial Engineering, Purdue University and will be held on the university campus, Lafayette, Ind. Additional information is available from Prof. James H. Greene, Dept. of Industrial Engineering, Purdue Universitv, Lafayette, Ind.

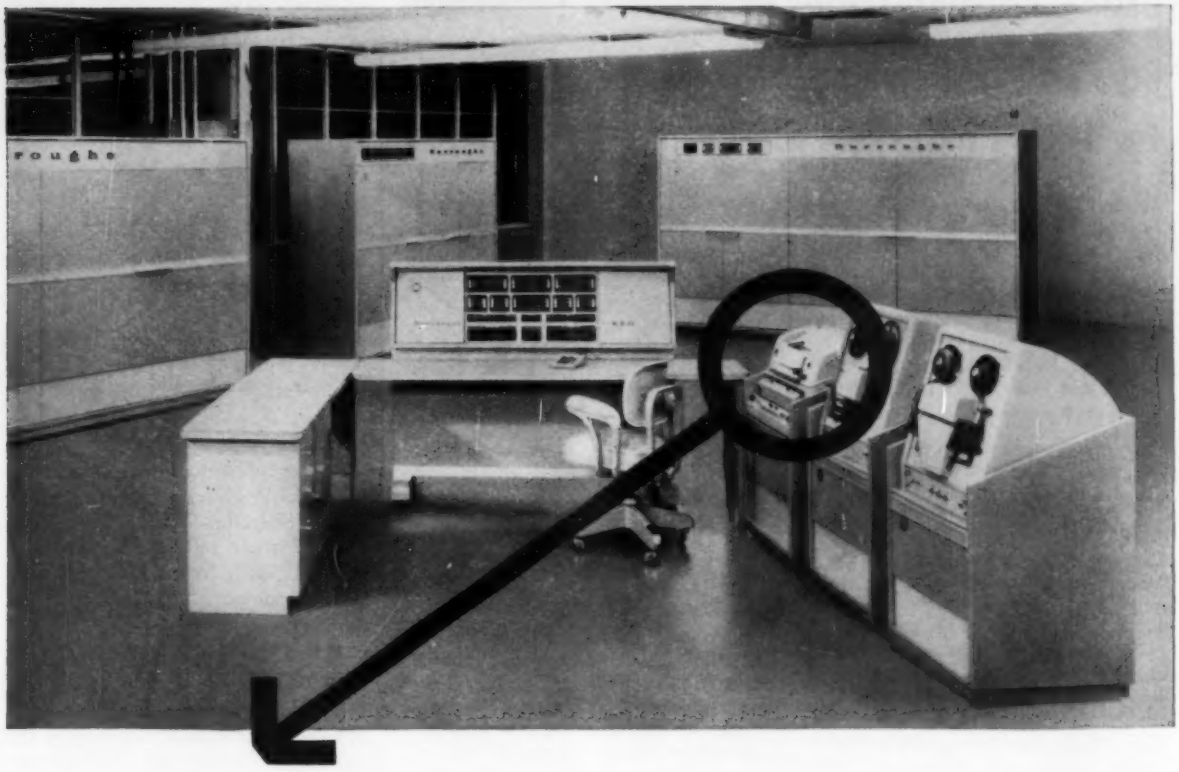
March 2-4—

American Management Association. Fifth annual Electronics Conference to be held at the Statler-Hilton Hotel, New York. Further information may be obtained from Donald G. Keen, AMA headquarters, 1515 Broadway, New York 36, N. Y.

March 9-10—

Steel Founders' Society of Amer-

Circle 664 on Page 147



Eight reasons why Burroughs chose Teletype Printer for the new 220

ElectroData Division of Burroughs Corporation made extensive tests and comparisons before choosing a supervisory and off-line printer for their new, high-speed electronic data processing system—the Burroughs 220.

Here are the eight reasons for choosing the Teletype Model 28 Printer:

1 Reliability. In actual test, the Teletype Model 28 Printer ran continuously . . . more than 20 times as long as other equipment tested.

2 Parallel Input. The Printer accepts parallel input information—desirable since the output from the data-processor is parallel.

3 Coding Flexibility. Type boxes used in the Model 28 Printer may be interchanged quickly and easily to suit a variety of code requirements. This feature is unique with Teletype.

Any code may be made to accomplish any non-printing function in the printer or to actuate a transfer contact—by a simple change in the Stunt Box (exclusive with Teletype).

4 Speed. The Model 28 Printer meets the speed requirement of 100 words per minute.

5 Readability. Quick reading of the copy is easier because type box moves across a stationary platen—rests out of the way between characters.

6 Tabulating. The Printer is equipped with a horizontal tab which is fast and adjustable. It has, also, an adjustable "Form-Out" for indexing printing on next printed form.

7 Appearance. The Teletype Model 28 Printer is housed in a well-designed, attractive cabinet.

8 Quiet Operation. Operating noises are reduced to a minimum by the sound absorbing cabinet enclosure.

More Information. The Model 28 Printer is one of several units in the all-new Model 28 line of Teletype equipment. If you would like more information on these new units, write to Teletype Corporation, Dept. 21-B 4100 Fullerton Avenue, Chicago 39, Illinois.

TELETYPE®
CORPORATION
SUBSIDIARY OF *Western Electric Company* INC.

Circle 665 on Page 147

DESIGN CONSIDERATIONS

Backlash in Indexing Mechanisms for High Production Machinery

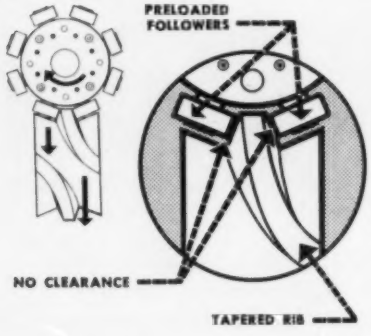
Backlash in indexing results in impact or shock loads that affect the efficiency of a machine and the quality of its product. Most indexing mechanisms have inherent characteristics that cause backlash and poor dynamic conditions and prevent the machine designer from taking full advantage of modern automatic feeds, tooling and methods that contribute so much to production economy.

Of the three principal indexing mechanisms, only one offers zero backlash and years of maintenance-free operation:

FERGUSON DRIVE

Continuously rotating cam includes a tapered rib, along which two preloaded bearing followers roll with no clearance between them and the rib. When the drive is in the rest, or dwell, position a straight portion of the rib locks the followers with *zero backlash* and an indexing accuracy of .001". Wear of the hardened cam is infinitesimal since it is subject to rolling friction only (many cams have been in use for more than 25 years). Followers are rated for a minimum of 8,000 hours precision operation at speeds up to 2,000 indexes a minute. If followers wear after this time, they can be replaced, thus renewing the drive for a like period.

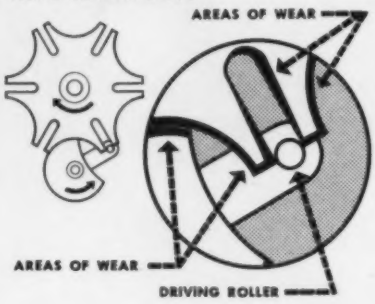
FIG. 1 FERGUSON DRIVE



GENEVA DRIVE

A geneva drive consists of a slotted wheel and a driver with a driving roller. Indexing occurs when the roller crashes into the slot, causing the wheel to move one increment. There must be clearance in the slot to allow passage of the roller. With clearance there must also be backlash. Impact loading, resulting from the inherent backlash, causes the slots to wear quickly and the backlash becomes progressively more severe. Operating speeds must be limited to contain the dynamic forces generated by backlash, even then, genevas require replacement with great frequency and downtime for maintenance is a major problem.

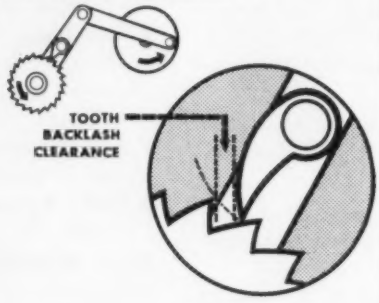
FIG. 2 GENEVA DRIVE



RATCHET & CRANK

Tooth clearance backlash causes the pawl to strike the ratchet teeth with considerable impact when indexing begins and vibratory forces are extreme. After mid stroke, the arm stops the pawl gradually but the wheel must be stopped by frictional braking or by positive means. Friction brakes allow over-travel and inaccuracy of index. They wear quickly and require excess downtime for maintenance. Because positive stopping is instantaneous, impact and rebound action of the wheel is tremendous. Neither method of stopping is satisfactory from the standpoint of low maintenance requirements or controlled dynamic conditions. Sustained high speed production is virtually impossible.

FIG. 3 RATCHET & CRANK



• SEND FOR CATALOG

Zero backlash is only one inherent advantage of the Ferguson Drive. Others are explained in an easy-to-use catalog containing load ratings and dimensions of many standard units, drawings and installation photos. There is a copy for every design engineer . . . Write **FERGUSON MACHINE CORPORATION, 7818 MAPLEWOOD INDUSTRIAL COURT, ST. LOUIS 17, MO.**

ica. 57th Annual Meeting to be held at the Drake Hotel, Chicago. Additional information is available from George K. Dreher, SFSA headquarters, 606 Terminal Tower, Cleveland 13, Ohio.

March 17-19—

American Machine Tool Distributors Association. Spring Meeting to be held at the Sheraton Park Hotel, Washington, D. C. Additional information is available from James C. Kelley, AMTDA headquarters, 1900 Arch St., Philadelphia 3, Pa.

March 19-20—

Society of Automotive Engineers. National Production Meeting to be held at Sheraton-Cadillac Hotel, Detroit. Further information may be obtained from John A. C. Warner, SAE headquarters, 485 Lexington Ave., New York 17, N. Y.

March 23-25—

Third Conference On Manufacturing Automation. Co-sponsored by Purdue University and AUTOMATION magazine, conference will be held at Purdue University, Lafayette, Ind. For additional information contact the Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio.

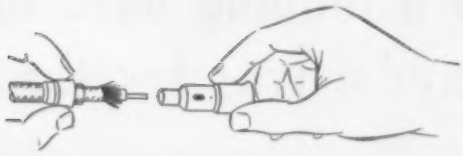
March 29-April 1—

American Society of Mechanical Engineers. Instruments and Regulators Conference to be held at Case Institute of Technology, Cleveland. Additional information is available from ASME headquarters, 29 W. 39th St., New York 18, N. Y.

"Burnside is invaluable to the company. He converts all our old machines into real money-makers!"

Circle 666 on Page 147

A



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DISCONNECT

IN SECONDS!

COAXICON—brand new. One stroke of the A-MP precision tool does it. Two strokes and you have the pin and receptacle units permanently attached to coaxial cable. For low level circuitry, either panel mounted or free hanging.

- Reliability—the highest. Cost—lower than anything you're now using.
- Further, coaxial cable is fully supported against vibration.
- All this in seconds . . . no more burned insulation . . . no more tedious soldering . . . no more doubtful connections. Attachments at unbeatable speed that give you the finest termination at the lowest total installed cost.

Write for more information today.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through subsidiary companies in: Canada • England • France • Holland • Japan

How a leading automotive manufacturer Snyder-izes for the Soaring Sixties

HOLDS PISTON WEIGHTS ± 2 GRAMS AT 600 PER HOUR

This Snyder transfer machine automatically weighs die cast aluminum pistons and mills them to tolerances of ± 2 grams at double the rate of the previous method. Here's how it turns out 600 parts per hour:

Pistons are transferred bottoms-up to orienting station.

Pistons are oriented in relation to the wristpin hole offset.

Pistons are spun right side up (below at right) while they are advanced to weighing station.

Precise overweight is transmitted by memory system to weigh-mill station during transfer.

A 3¼" milling cutter removes excess with the piston clamped in position.

Gaging station re-weighs pistons to check weight. Deviation from part tolerances stops machine.

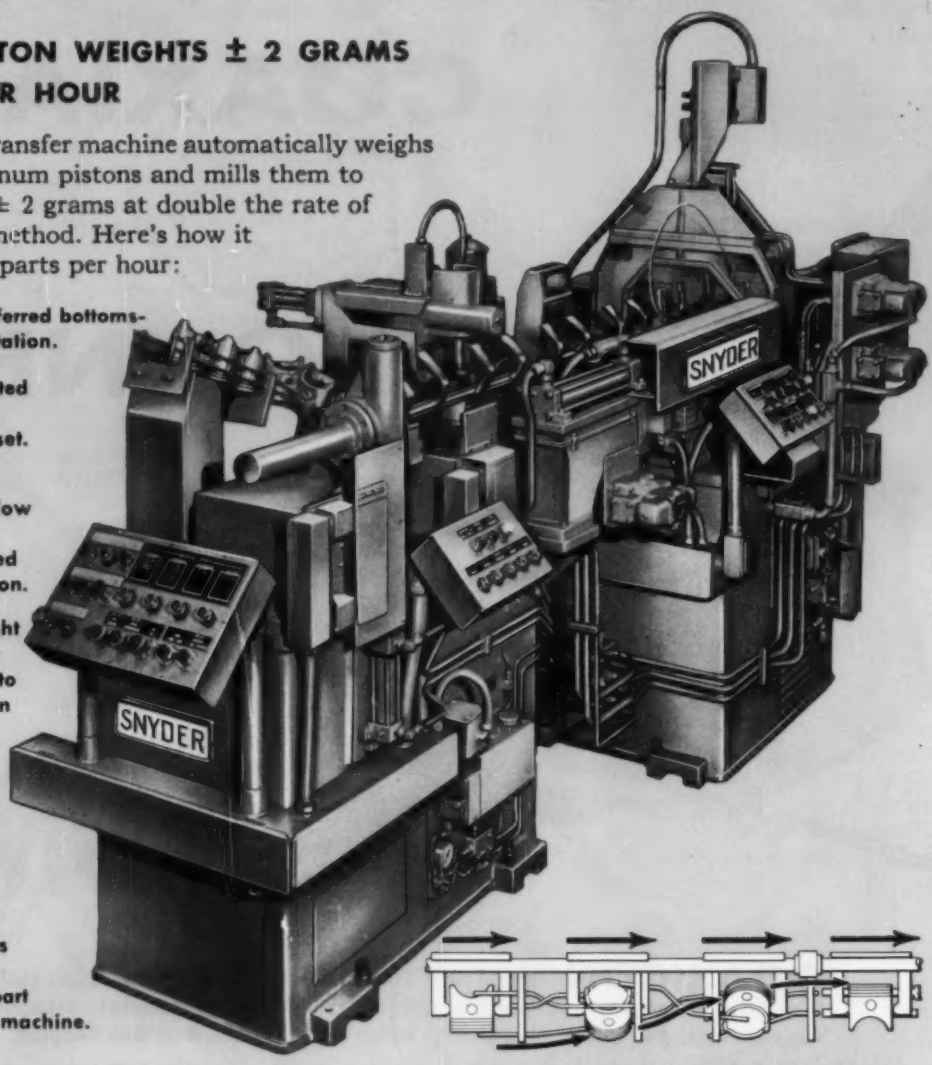

Diagram shows end over end rotation of piston as it passes through spiral rails.

Do your manufacturing cost problems revolve around parts handling, gaging and assembly as well as machining? Ask us to show you the benefits of SNYDER-IZING FOR THE SOARING SIXTIES. For a resume of SNYDER special machines engineered for profit opportunities, send for our new brochure or phone.

SNYDER
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(Formerly Snyder Tool & Engineering Company)
3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123

Circle 668 on Page 147

detroit dateline

By JAMES C. KEEBLER Managing Editor

Another Milestone Passed

ONE THING that can be said for the genuine original milestone is that you just don't hardly see any around anymore. Maybe it was the automobile that obsoleted the milestone. In the not too distant past one could drive along US 40 (the old National Highway) and pass one of those things every mile. As the term implies, the real McCoy was made of stone. On one face the passer could read how many miles lay ahead to the next city, and on the other side he could see how far he'd come from the last city. These monuments to Conestoga travel were by and large 'dozed over to make way for four-lane traffic.

More Meaning

Webster goes quickly from the original definition of the word to, "hence, an important event in a man's life."

In this sense of the word the man that coined the word *automation* has just passed another milestone. Del S. Harder has retired as vice president and technical adviser to the president and the chairman of the board of the Ford Motor Co. Capping an automotive career that began 47 years ago Harder will no longer have operating duties in the corporation, but will continue as a member of the company's board of directors.

Ford Motor Co. literature credits Harder with the origination of the word *automation*, and notes that it has become one of today's most highly publicized industrial developments. Dutifully it is noted that automation has been ranked in importance second only to the moving assembly line, first conceived and put into operation by Henry Ford at his Highland Park, Mich. plant in 1913.

Surely Harder can be considered a pioneer of the modern techniques of manufacturing automobiles. AUTOMATION magazine has always taken great pride in the fact that this man wrote a feature article that keynoted Vol. 1—No. 1.* He has not only been a pioneer, but has contributed generously of his thinking to the technical literature of the age, so that industry as a whole might follow his milestones.

Although other automaking companies have been a bit reticent to use the word automation in their technical pronouncements, none have failed to automate as fast as their talents and budgets would permit. Some authorities have suggested that GM and Chrysler soft-pedaled the word because they were afraid Reuther would cram it back down their throats. Other observers, who have been unable to see any instance where Ford has had to swallow hard because it calls a spade a spade, have suggested that GM and Chrysler haven't promoted use of the term because it was Harder's term and Harder is a Ford man. Surely no one but Ford will claim their engines have "T-Bird go."

D. S. Harder, top production executive at Ford, whose retirement was announced effective Jan. 31, 1959, is the man who coined the word *automation*.

More Action

Recognition of words is certainly not as significant as recognition by actions. In announcing Harder's retirement Henry Ford II cited him as having played a key executive role in the company's postwar reorganization and facility expansion programs. Anyone who has followed automotive developments in the technical journals knows that every stamping and engine plant built since the war can be said to be an embodiment of Del Harder's automation philosophy. This applies regardless of whose name is above the door.

Harder was born 66 years ago in Delhi, N. Y. and started out in this business in 1912 with the Yellow Taxi Cab Co. Two years later he joined the Chevrolet Motor Co. in New York as a director of the testing and repair division. Later he became plant superintendent. A few years after GM acquired Chevrolet, he was assigned to the firm's tractor plant in Janesville, Wis. He resigned this post to join Durant Motors in Oakland, Calif. and later at Elizabeth, N. J.

In 1928, Harder went to Detroit as plant manager for the E.G. Budd Mfg. Co. He joined the Fisher Body Div. of GM in 1934 as general factory manager of the fabricating division. He was named president of the E. W. Bliss Co. in 1945.

Harder joined Ford in 1946 as vice president-operations after resigning as president of the E. W. Bliss Co. In 1955, he was elected executive vice president with direction over all of the company's nationwide basic production operations and staff manufacturing activities,

*D. S. Harder—"Automation—A Modern Industrial Development," AUTOMATION, Vol. 1—No. 1, Aug. 1954.

a post he held until April 1958.

The word automation, as originated by Harder, was initially used to describe a system for the automatic handling of parts through progressive production operations. Exactly when Ford first utilized automatic handling between production operations has not been established. Certainly the idea was developed before the word automation was coined. The word, however, made its formal debut in 1947 when a section of production engineers whose job was designing work-handling devices was renamed the Automation Department.

Increased applications of automation within the past decade have broadened substantially Ford Motor Co.'s definition of the word. Today, Ford engineers look upon automation as an entirely new philosophy of manufacturing embracing a consideration for all the manufacturing operations—designing, producing, inspecting, assembling, testing, handling and packaging.

More Automation

Automation grew at Ford in small stages. The first application was on a valve guide bushing. The automatic handling came into play by a method of turning this part so that its large end always first entered a conveyor which took it through machining operations.

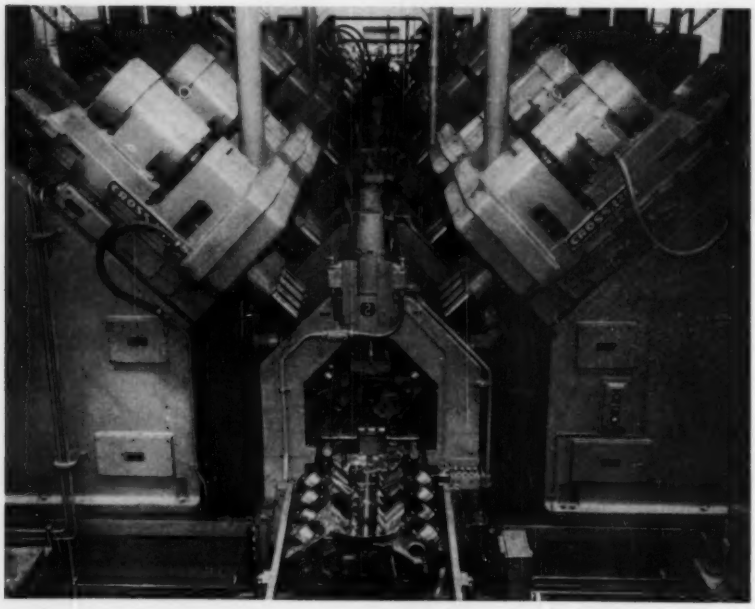
Imagination of this kind soon began to be applied at Ford to the handling of many other items. Automation's first really spectacular success occurred when it was applied as a means of loading and unloading stamping presses. Another early use of automation was to transfer hot, heavy coil springs from a coiling machine to a quench tank, a job which before automation was called "mankilling," because the operator had to reach down, lift the hot part to chest height, turn around and put it in a compression fixture for quenching, all within seconds.

The early successes led Ford to design a complete plant around the automation concept. This was the Buffalo stamping plant which went into operation in September, 1950.

The second and third plant-wide applications of automation by Ford were made in 1951 when the company opened its foundry and first engine plant at Brookpark Village, Ohio in the Cleveland area.

Now, nearly every manufacturing plant which Ford operates makes use of automation to some extent. The latest Ford facilities to be extensively automated include a new engine plant at Lima, Ohio, a stamping plant at Chicago Heights, Ill., and a chassis parts plant north of Detroit.

Although started out as a centralized company function, with the Automation Department as a focal point, automation has since followed a decentralized pattern and now the company has automation engineers in nearly every plant.



Typifying the Harder automation philosophy is this 50-foot long transfer machine that processes engine blocks at the newest Ford engine plant at Lima, Ohio. Sixteen operations are performed here. Dust extracting tubes in the center remove all cast iron dust from the area.

More Milestones

Automakers not only look at Harder's milestones to see where they've been, they ask him to speak at SAE meetings and tell them where they are going. At the Production Activity Luncheon as part of the 1959 SAE Annual meeting on Jan. 15, Harder took a look at the changing concerns of production management. Noting that automation won't obsolete people, and that Europeans are automating even though their labor costs are lower than ours, he saw real competitive challenges ahead.

Recalling the traditional role of the production executive as " . . . a brawling, cussing, tobacco chewing despot . . . supposed to be a cum laude graduate of the school of hard knocks, and to have an unveiled contempt for any kind of book learning," he summed up his remarks with the recognition of another milestone passed by saying:

"There may be a few areas left in industry where the 'Bull of the Woods' still holds sway, but they are diminishing every day. The rapid march of progress in manufacturing has ushered in problems that call for men with broader minds, men able to look beyond the lathe and the drill press and the drop hammer to the broader scope of the world and its economic problems. I don't mean that a production executive necessarily has to be an expert in international affairs or educational techniques. In most large companies he can turn to colleagues who are expert in such fields. But he will need to be broad gauge in understanding and able to grasp the significance of trends and far away developments that impinge on his job."

The advent of such management philosophies should help us pass many more automation milestones.

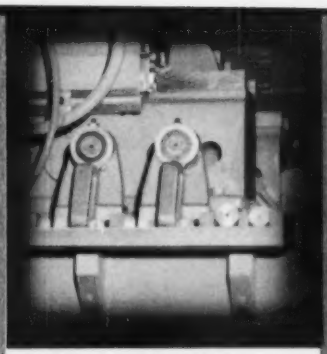
Circle 669 on Page 147→

remove all cast iron dust from the area.

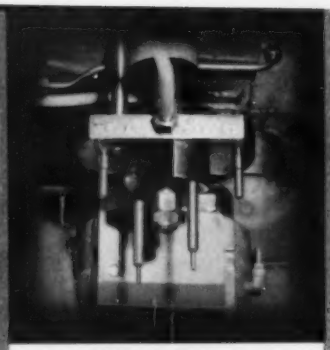
philosophies should help us pass many more automation milestones.

Circle 669 on Page 147→

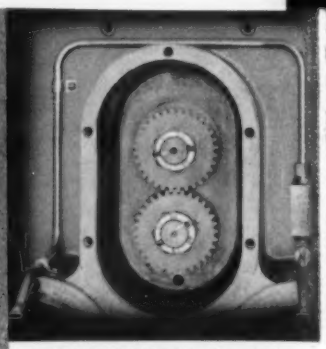
CLEANLINESS: Fixtures and parts are washed on return conveyor.



SETUP & TOOL CHECK gages are provided at all key stations.

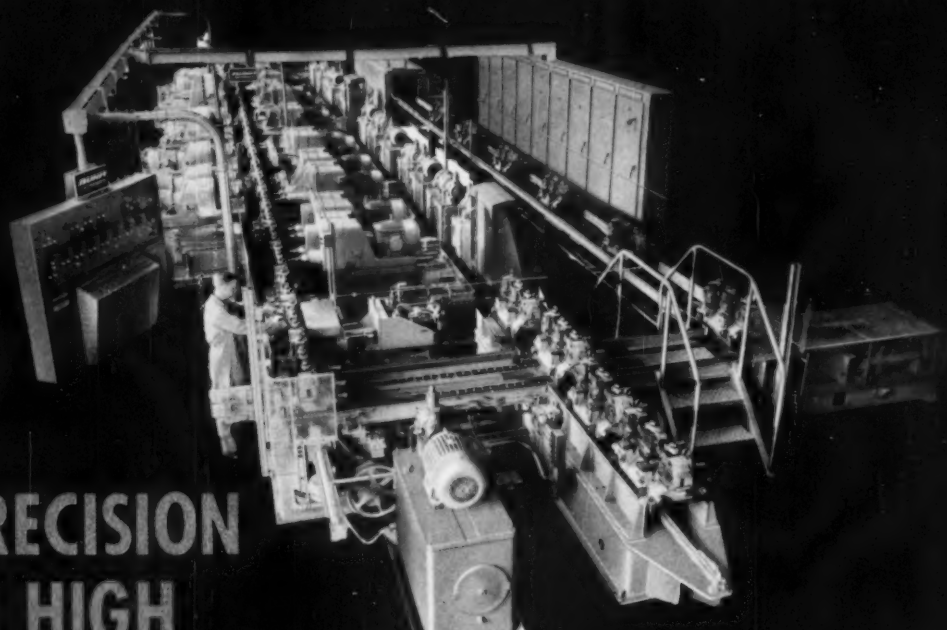


PROBING stations at key points locate and signal any tool breakage.



CHANGE GEARS in heads for changing cutting speeds if desired.

A



PRECISION IN HIGH PRODUCTION

Tolerances as close as a few tenths can be maintained on Buhr ECONOMATICS when required

PART—hydraulic

CYCLE TIME—24

OPERATIONS—11

STATIONS, total—

OPERATIONS—dri
reaming, sp
form-groov
probing an

TOLERANCES—as
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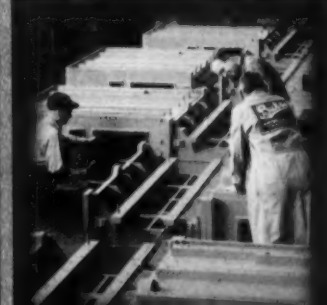
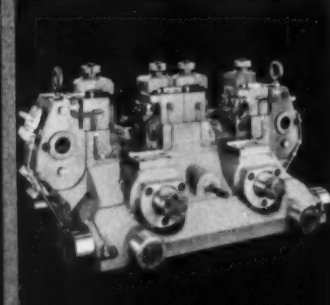
SPOT GAGING of parts in process without stopping machine.

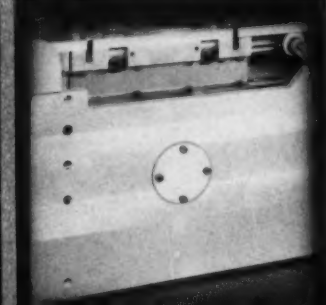
BUHR "BUILDING-BLOCK" construction does not sacrifice rigidity.

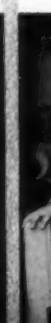


PRECISION BUILT FIXTURES give 100% parts interchangeability.



CONVERTIBILITY is further aided by providing 10 future potential work-stations.





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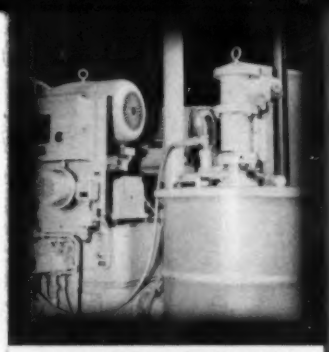
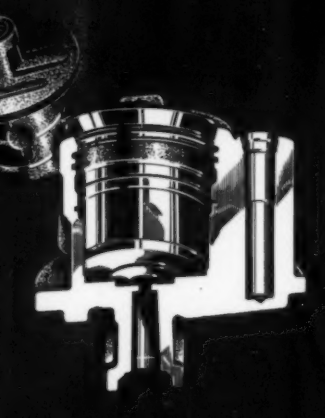


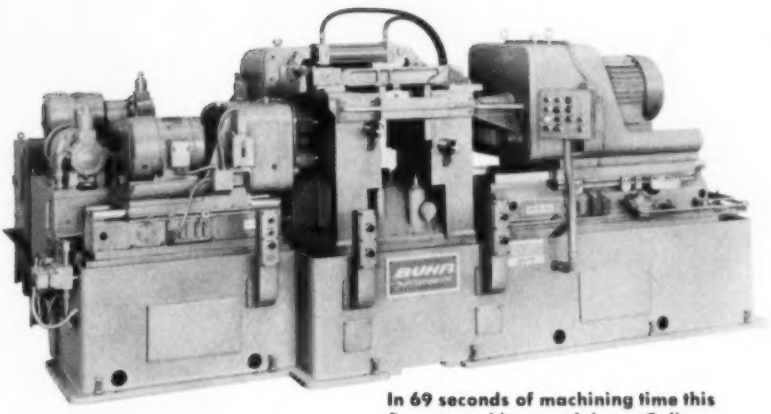
AUTOMATIC LUBRICATION of entire machine except motors.



RT—hydraulic pump housing
LE TIME—24 secs. for 2 parts
RATIONS—115
TIONS, total—26 stations
ERATIONS—drilling, tapping, reaming, spot-facing, boring, form-grooving, feed-out facing, probing and gaging
ERANCES—as low in some cases as a few tenths of a thousandth with excellent surface finish

rther
10
ations.

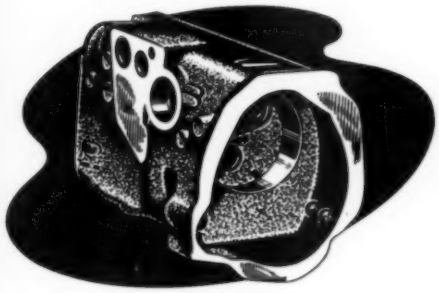
GOOD ACCESS for tools etc., provided by ample room between stations.



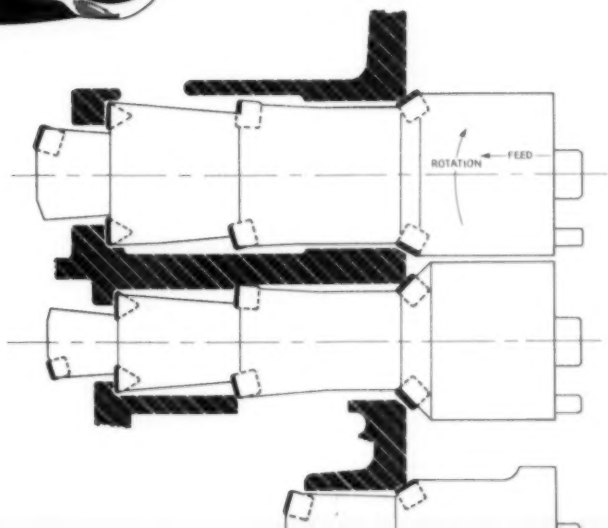
In 69 seconds of machining time this 3-way machine rough bores 9 diameters, semi-finishes 4 bores, machines 7 chamfers and 3 faces.

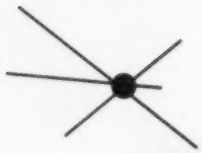
ECONOMATICS SAVE MONEY IN LOW PRODUCTION, TOO

By combining numerous operations through multi-diameter boring tools, using throwaway inserts, only 4 simple 2-way and 3-way Buhr Economatics produce all bores in the transmission housing for one of the major tractor producers.



Diagrammatic sketch below shows the three spindles of the right-hand head of the machine illustrated above. Throw-away inserts are combined in specially designed tools to rough bore, chamfer and face various openings. Related dimensions can be held closely because they are formed by the same tool. Tool grinding is unnecessary and set-up time is minimized.





BUHR

MACHINE TOOL COMPANY specializes in the design and construction of practical versatile multi-operation machine tools.

Basic features stressed in all Buhr machine tools include:

QUALITY—rugged design and manufacturing accuracy are combined to provide long trouble-free operation.

CONVERTIBILITY—Buhr uses standardized "building-block" parts wherever possible in its machines, fixtures, etc. All such parts are held to interchangeability tolerances.

PRODUCTIVITY—dependability is designed and built into Buhr machines to insure maximum productivity per man-hour consistent with production requirements.

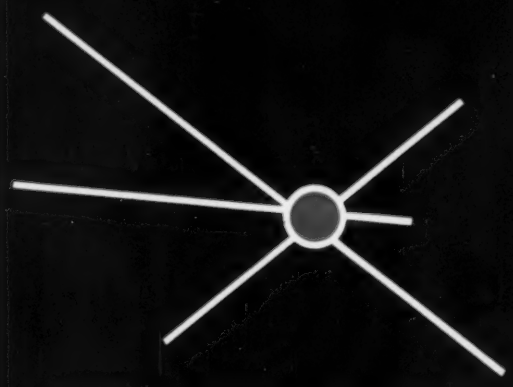
LOW DOWN TIME—every effort is made to minimize downtime by careful attention to future maintenance requirements, etc.

VERSATILITY—Buhr machines have a well-earned reputation in industry for their versatility. Many can produce a variety of parts with minimum changeover time.

Buhr welcomes the opportunity of discussing your machining requirements. Give us a call or drop us a line.

BUHR
MACHINE TOOL COMPANY

ANN ARBOR, MICHIGAN



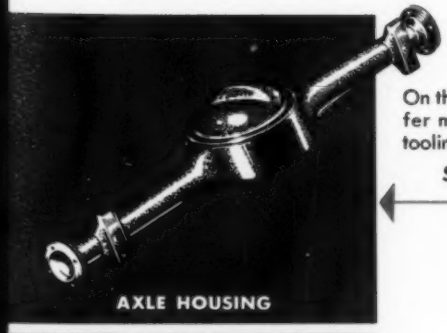
BUHR

the symbol of quality in multiple operation high and low production equipment

two more examples

Typical jobs on various *BUHR* Economatics

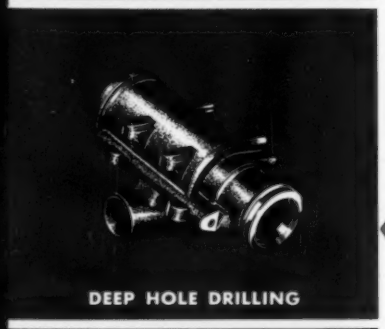
Any random selection is naturally incomplete. If you don't see a part that looks like yours, send us a part print and we will be happy to tell you what Buhr Economatics are doing to cut costs on your type of part.



AXLE HOUSING

On this part, a short Buhr Economatic transfer machine has eliminated an annual retooling cost averaging $40,000 per year.

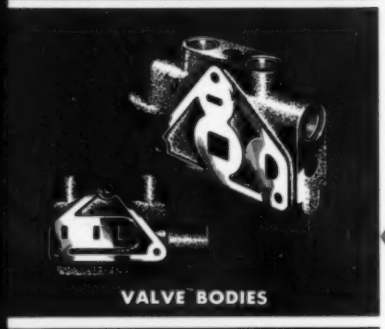
Short Transfer Machine #C-5188



DEEP HOLE DRILLING

On this conventional Economatic, a ¼" hole is drilled 7¾ in. deep in 5 steps (2 parts at a time). A proximity switch stops machine if a drill should break.

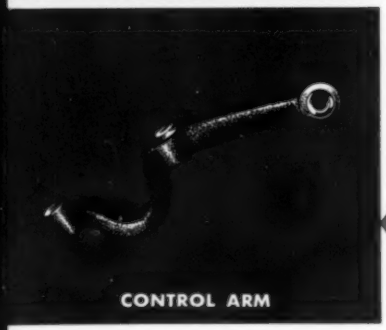
Dial Index Machine #C-5117



VALVE BODIES

From 19 to 28 operations per part are performed on 32 different valve body styles on the same machine with only simple tool changes.

Trunnion Machine #C-5021



CONTROL ARM

A 4-station 3-way (2 horizontal, one vertical) dial index Economatic for drilling, reaming and facing control arms.

3-way Machine #C-4005

ROAD MACH'Y PARTS

7 different road machinery parts are produced on one automatic machine. Settings for different parts are pre-selected with a dial switch.

Shuttle-type Machine #C-4552

MANIFOLDS

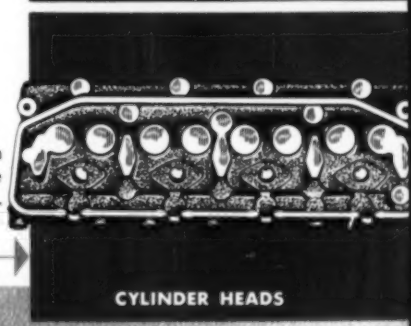
Cast manifolds (both LH and RH) are produced at a rate of one every 21 seconds on a 20-station machine.

Transfer Machine #C-4524

ALUMINUM OR CAST IRON

43 operations are performed on either aluminum or cast iron housings at 21 stations. Time cycle is 21 seconds per part.

Transfer Machine #C-4098



CYLINDER HEADS

All spark plug holes are combination drilled and reamed on a simple 2-fixture 4-station machine with a 12-spindle head.

Single-station Machine #C-4941

Ask for more information by machine number

BUHR MACHINE TOOL COMPANY

ANN ARBOR, MICHIGAN

IT'S NO TRICK TO GET A "SPECIAL" TRUCK FROM THOMAS

This Thomas Balance Truck has a Q3 superstructure originally designed for safe handling of packages, paper and boxes. The three-sided steel panel design can be "Job-Suited" in various heights and pushbar arrangements.

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Thomas builds hundreds of trucks to carry loads up to 50 tons and to work with all the latest powered equipment. Any one of these trucks can be "Job-Suited" with standard superstructures designed and built to hold your particular loads. An out-of-the-ordinary superstructure may speed up loading and unloading, carry your loads safely—save time, manpower and materials . . . actually save many times its cost.

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"Power-Suited" all-duty trailers, 1,000 to 10,000 lbs.

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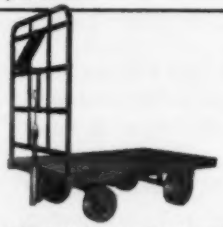
Platform for use with both Jack and lift trucks.

Economical multiple-storage stacking boxes

Safety one-man drum truck



Adapted for overhead and underfloor towing.

Puts parts at machine height.

Elevated three-sided panel truck.

Rack truck for parts or tote pans.

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is ready to help solve your handling problems. Write for your free catalog describing the complete line of Thomas "Job-Suited" Trailers, Trucks, Casters, Wheels and "Jak-Tung" Systems.

Only THOMAS Makes "Job-Suited" Trucks

THOMAS TRUCK & CASTER CO.
919 Mississippi River
Keokuk, Iowa

Circle 670 on Page 147

RIVETT SQUAREMASTER "100" CYLINDERS

Unfailing POWER for MILLIONS of cycles!

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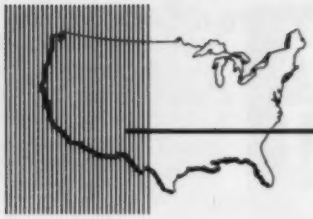
Send for catalog. Proof of SQUAREMASTER efficiency stated in these 20 pages. Write today.

RIVETT furnishes a complete power package

AIR AND HYDRAULIC—VALVES, CYLINDERS, POWER UNITS

Member — National Fluid Power Association

Circle 671 on Page 147



western trends

By PATT PATTERSON
Los Angeles, Calif.

Wheels for the Big Three

INFLUENCE of the aircraft and missile industries upon the economy and production methods in the West has been well publicized. As has been noted in this column, major manufacturers are not only developing and using automatic equipment, they are also urging automation upon suppliers. There is, however, considerably more to the story of automation in the West—and much of it is to be found outside the aircraft and missile industries.

Supplying of automotive parts and components is one example. California is one of the largest markets for Detroit's ever-changing product lines. The Big Three maintain assembly plants in both Southern California and the San Francisco-Oakland Bay areas, main centers of automotive ownership. As a result, a seldom recognized group of suppliers has emerged to supply those parts and components which are more economically purchased on the Pacific Coast compared with shipping from the Midwest.

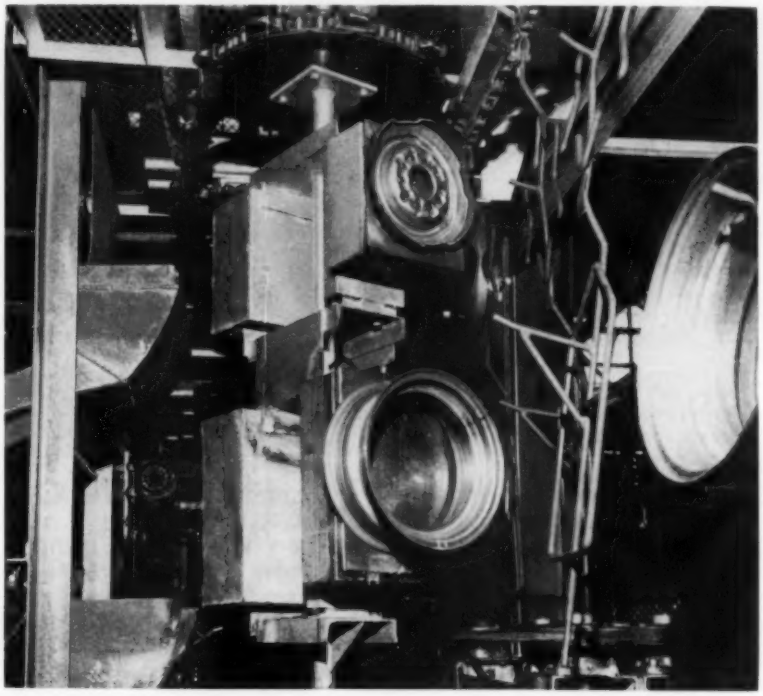
One of the larger suppliers is the Norris-Thermador Corp. which produces passenger car and truck wheels for the Big Three. Ford and Mercury passenger cars, Ford commercial vehicles, Chevrolet, Buick, Oldsmobile, Pontiac, Plymouth, Dodge, and Desoto are all supplied by the Vernon wheel plant.

In order to improve quality and increase output, Norris-Thermador engineers have turned to automation. The rim line, for example, is operated by one man in a control pulpit. This single operator controls the steel strip which is fed through three rim rolls, an automatic welding station, and a final sizing expander which spreads the rim to exact dimension. The finished rim is then automatically gaged and finally passes to a visual inspection station.

The inspector hangs the rims on monorail racks, where they meet wheel spiders made on a press line. At a semiautomatic welding station, the pairs of rims and spiders are transferred from the conveyor racks to gravity chutes by an interesting magnetic transfer.

This transfer is chain-driven and is phased with the monorail. As each rack containing a spider and a rim comes into position, one of two double sets of magnets lifts the parts from the monorail, rotates through 180 degrees, and drops the parts into separate gravity feed chutes which lead to the welding line.

The magnetic devices were designed by engineers in the plant. The basic philosophy behind using magnetic pickoffs instead of mechanical units was dictated by a desire to do the job as efficiently and as simply as possible. During construction of the line, investigation of mechanical units convinced Norris-Thermador engineers that a magnetic unit would have a number of advantages. The transfer uses 220v dc from a rectified source, and the magnets will attract a 20 pound weight across a 9-inch air gap—a force which provides a great deal of reserve for the job to be done. The transfer is capable of



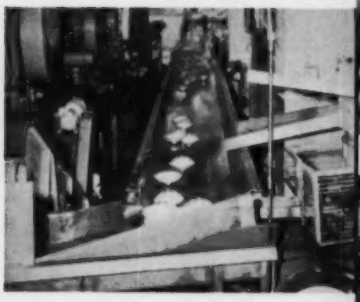
Auto and truck wheels for assembly plants are produced at Norris-Thermador Corp. plant. Magnetic transfer picks spider and rim from monorail rack, rotates 180 degrees, and drops parts into chute leading to weld station.

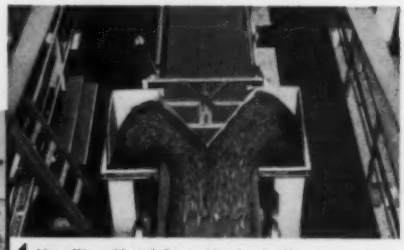
IT WILL, IF THESE ADVANTAGES ARE IMPORTANT TO YOU.

- *A strong, impermeable conveying surface of solid steel that —*
- *Resists oil, heat, impact and abrasion*
- *Lets products ride or slide, simplifying live backlogging and automatic discharge.*

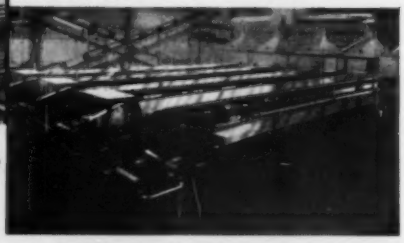
For more information without obligation write or phone your nearest Sandvik office.

Handling Bulk Materials ▶



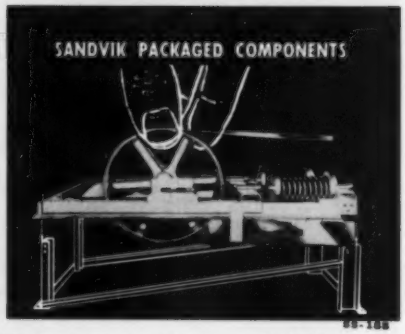


◀ Handling Metal Parts Up An Incline



Sandvik Water-Bed Conveyors Cooling & Solidifying Chemicals ▶

You Can Buy It Complete Or Build It Yourself With



In addition to complete, custom-engineered steel belt conveyors, Sandvik supplies conveyor components in packaged unit assemblies. For example, from Sandvik you can buy the tension end assembly, drive end assembly, steel belt, idlers and discharge devices and Sandvik will provide engineering assistance to help you build or convert to a steel belt conveyor.

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SANDVIK STEEL BELT CONVEYORS

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Sandvik Canadian Ltd., P. O. Drawer 1335, Station O. Montreal 9, P. Q.
Manufacturers of Steel Belt Conveyors for Over 40 Years.

800 drops per hour.

The operator on the welding line has a series of control switches which permit him to inactivate the transfer when the gravity chutes become loaded. He can select either rims or spiders, place the transfer on full automatic, or cause it to bypass all of the racks until the stock at his station has been reduced.

Wheels to be painted at the Vernon plant are racked by the inspector and sent through a spray cleaning to a Bonderizing dip, then through automatic spray booths, a drying oven, and over an overhead monorail to the separate warehouse.

Because of the savings inherent in automatic production, Norris-Thermador is able to competitively produce wheels of the same quality standards as Detroit.

Missile Checkout

One of the greatest drawbacks to the liquid oxygen-liquid fuel combinations in missiles has been the necessity for filling the weapon's tanks, and performing a completely detailed "countdown" before launching. Solid fuel missiles do not have to be fueled just before launching, but the countdown is still necessary to insure that the larger missiles' guidance systems and control circuits are all ready to perform properly.

To speed up the lag between warning and firing a missile of this type, automatic countdown or checkout equipment has been developed by a number of manufacturers. North American Aviation has had two divisions working on the problem. The Autonetics Div. and the Missile Div. have both developed units that do the countdown automatically, notifying the operating crew only if a certain phase of the checkout indicates a malfunction in the intricate internal system of the weapon.

Recently, the efforts of both divisions have been combined, and a merging of the independent developments is taking place. It is known that one approach was to use a multichannel punched tape to program the checkout. This system included a number of automatic comparison networks to insure that information received in the test was correct. The method that will finally be adopted by North American has not yet been settled.

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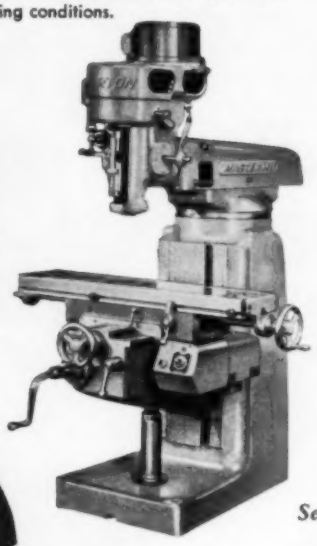
FRACTIONAL HORSEPOWER AJUSTO-SPEDE® DRIVES

Parker Majestic No. 2 Universal Grinder is equipped with two Ajusto-Spede Drives. One drive, mounted on the headstock, rotates the work against the grinding wheel. Another drive operates the table feed. Both work speed and table speed are infinitely adjustable to suit varying conditions.

Wherever infinite adjustment and accurate control of speed are required for proper machine operation, satisfied users are realizing improved machine performance and product quality through the use of Dynamatic Ajusto-Spede Drives. Stepless adjustment from zero to full output speed, and accurate control of any speed within the range, permit operation at the exact speeds required.

Ajusto-Spede Drives operate on standard 115/220 volt alternating current, requiring no special power source. The compact drive with its integral control system needs no wall space, and requires little space on the driven machine. These drives may be mounted in any position, providing great versatility of application. Twelve models are available in ratings from ¼ hp at 1650 rpm through 1 hp at 3200 rpm.

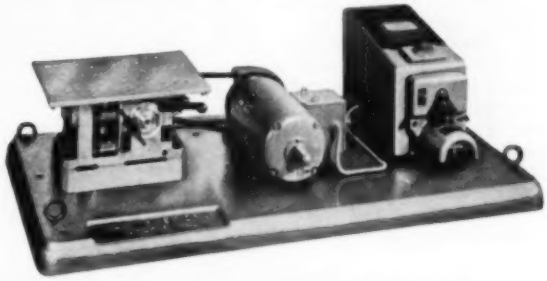
Before you specify a fractional horsepower drive for your product or plant equipment, check the many advantages offered in the Dynamatic Ajusto-Spede Drive.



A Dynamatic Ajusto-Spede Drive provides infinitely adjustable table feed speeds on a Gorton Mastermil. Stepless adjustment permits the operator to select the proper table speed for maximum efficiency in machining all metals.

Send for Your Free Copy of Illustrated Bulletin FAS-6 which Describes Dynamatic Ajusto-Spede Drives

Harnischfeger Welding Positioner WP-1 uses an Ajusto-Spede Drive and gear reducer to rotate welding table. Table speeds are infinitely adjustable from zero rpm to 4.47 rpm. Drive tilts with table to the position desired by the operator.



Vibration Fatigue Testing Machine manufactured by the All American Tool and Mfg. Company employs an Ajusto-Spede Drive to operate a vibrating table at various speeds for testing instruments and electrical components.

EATON

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DYNAMATIC DIVISION
MANUFACTURING COMPANY
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Circle 673 on Page 147

AUTOMATION TIPS
by McGill

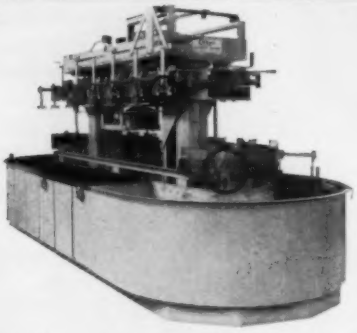
CAMROL® bearings...save the cost– and inconvenience–of improvised followers in automated machinery

Why go to the trouble of "building up" special roller followers when CAMROL cam followers can provide so many construction advantages in a standard bearing? Select the proper size from roller diameters of ½" to 4" in either the CF (with stud) or CYR (for shaft mounting). It saves time and money when applying roller followers to cam follower, track, guide and support roller applications.

The McGill construction is backed by over 25 years experience with thousands of applications. Selected steel, tested design, special heat treatment and simplified lubrication insures the dependability of CAMROL — the original roller bearing cam follower.

For protected performance, SCF Series Sealed Camrol Bearings provide the added advantages of better lubrication retention and sealing against dust, dirt and other contamination. Frequent relubrication can be avoided.

AUTOMATIC PLATING MACHINES USE CAMROL BEARINGS

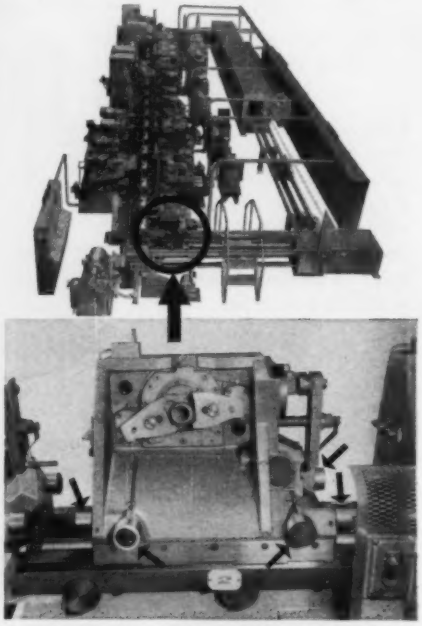


CROWN RHEOSTAT AND SUPPLY COMPANY uses up to 200 Sealed CAMROL cam followers as guide and support rollers in the travel and transfer mechanisms of their cleaning, plating and drying machines. The machine shown here is a CROWN Type "D" Fully Automatic Plating Machine. The CAMROL bearings assure precision action, reduced friction and minimum maintenance. Built-in seals protect the bearings from cleaning and plating solutions.

FOR COMPLETE ENGINEERING DATA ON McGILL PRECISION NEEDLE ROLLER BEARINGS, SEND FOR BEARING CATALOG NO. 52-A

FIXTURES ROLL FREE— and accurately on Sealed CAMROL bearings

Production parts are drilled, milled, bored and tapped in automated systems engineered and built by the BUHR MACHINE TOOL COMPANY. The moving fixtures which hold parts being machined are guided and carried on McGill sealed CAMROL bearings as shown in the close-up below.



By reducing the starting and running friction to an absolute minimum, the CAMROL bearings have made horsepower requirement reductions possible in these systems. Ample load capacity, high resistance to shock loads and integral seals which retain lubrication and keep out contamination have held maintenance down. In the system pictured, 8 SCF-3 CAMROL bearings accurately guide and support each of 28 fixtures. Performance is reported excellent.

engineered electrical products

McGILL®

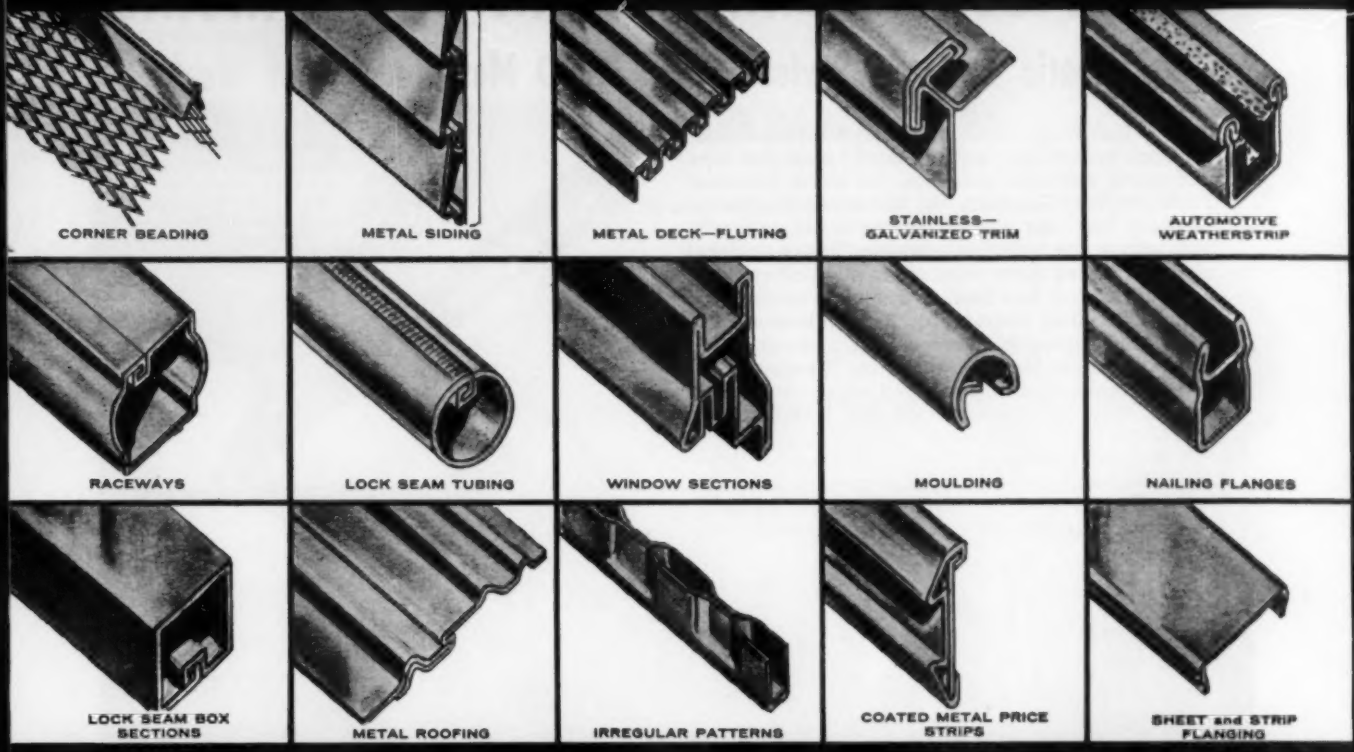
precision needle roller bearings

SEND FOR CATALOG No. 52-A

MULTIROL — GUIDEROL — CAMROL

McGILL MANUFACTURING COMPANY, INC., BEARING DIV., 401 N. LAFAYETTE ST., VALPARAISO, INDIANA

The Shapes of Things to Come



COME FROM *McKAY* FORMING LINES

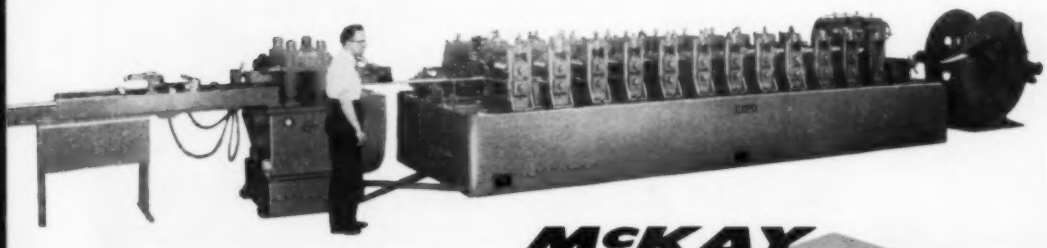
Two words that best describe McKay Forming Machines are "precision" and "ruggedness."

McKay Forming Machines are the last word in quality. They're designed and built to perform with extreme accuracy year after year. McKay users the world over know that quality is never sacrificed, even in the smallest details, for the sake of marketing a "cheaper" unit.

And McKay Forming Machines are built to customers' requirements with an eye to the future. They're machines that will not only meet today's needs, but machines that are ready for the faster speeds, tougher metals and more intricate shapes of tomorrow.

Be sure you have checked with McKay before you order forming equipment. You'll find this unmatched precision and ruggedness pays off in better forming at greatly reduced costs. And with a McKay—you're ready for tomorrow!

The McKay Machine Company, Youngstown, Ohio



McKay Forming Machines are quality throughout. They're designed and built to deliver year after year with minimum maintenance. Note sturdy construction of machine pictured above.

McKAY McK MACHINE

Circle 675 on Page 147

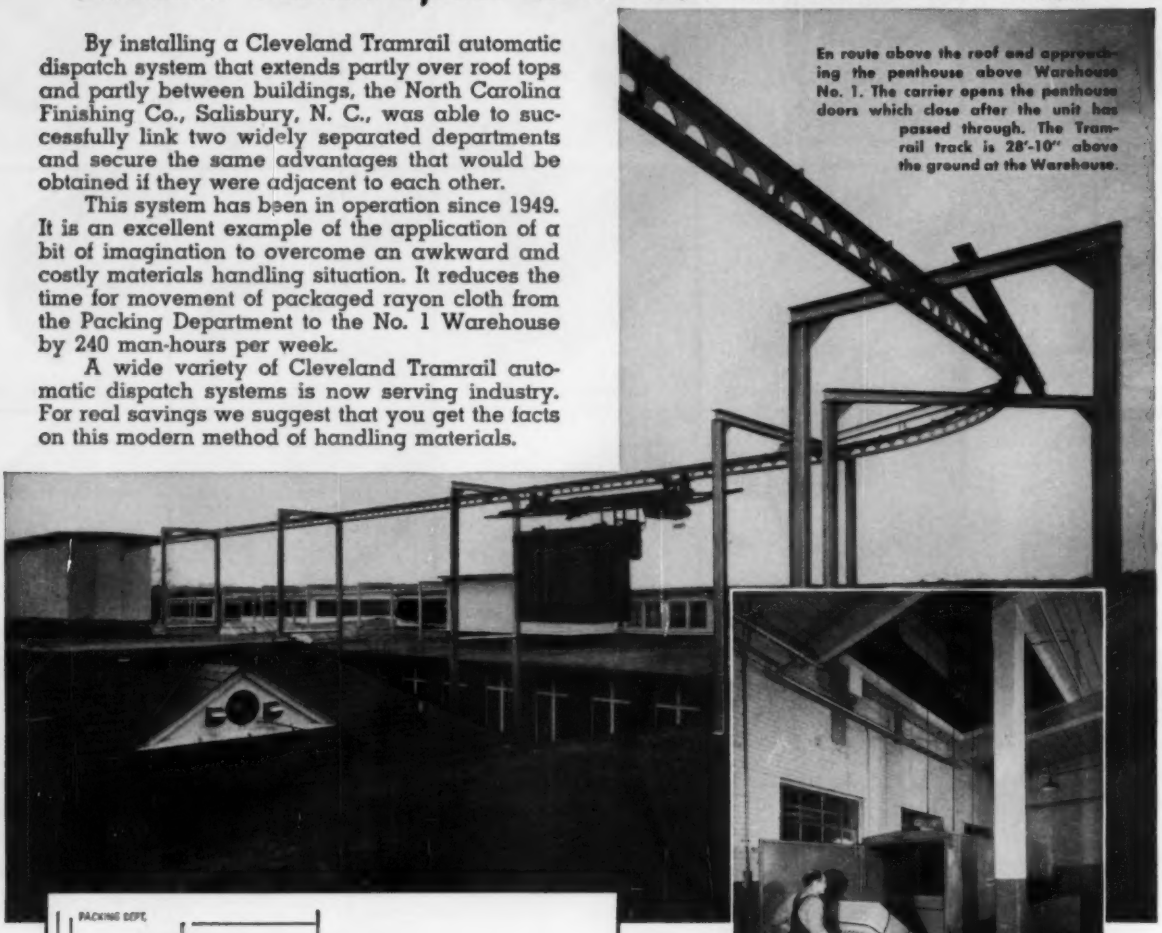
Uses Roof To Link Distant Departments

Automatic Tramrail System Saves "240 Man-Hours" Per Week

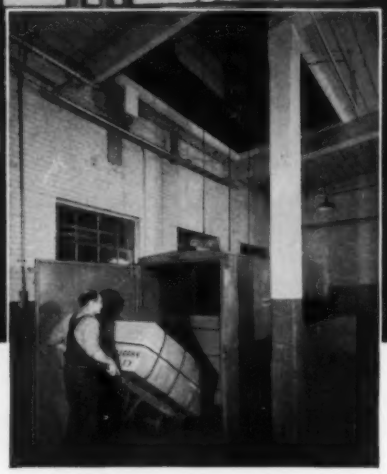
By installing a Cleveland Tramrail automatic dispatch system that extends partly over roof tops and partly between buildings, the North Carolina Finishing Co., Salisbury, N. C., was able to successfully link two widely separated departments and secure the same advantages that would be obtained if they were adjacent to each other.

This system has been in operation since 1949. It is an excellent example of the application of a bit of imagination to overcome an awkward and costly materials handling situation. It reduces the time for movement of packaged rayon cloth from the Packing Department to the No. 1 Warehouse by 240 man-hours per week.

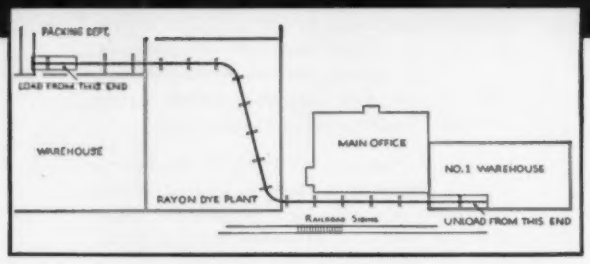
A wide variety of Cleveland Tramrail automatic dispatch systems is now serving industry. For real savings we suggest that you get the facts on this modern method of handling materials.



En route above the roof and approaching the penthouse above Warehouse No. 1. The carrier opens the penthouse doors which close after the unit has passed through. The Tramrail track is 28'-10" above the ground at the Warehouse.



6 to 8 cartons weighing 100 to 400 lbs. each are loaded into the Tramrail freight van. The button on wall, at left, sends the van on its way, first upward through ceiling opening, and then forward on outside roof track. The van measures 4'-0" x 8'-0" x 6'-6" high.



GET THIS SPECIAL REPORT
Write us for your free copy of "AUTOMATIC DISPATCH PORTFOLIO" Gives data on a variety of cost-reducing automatic handling installations.

CLEVELAND TRAMRAIL DIVISION
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CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT

Circle 676 on Page 147

Circle 677 on Page 147→

PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS

Bronze cartridge gland with "LIPSEAL"® and "WIPERSEAL" can be easily replaced without dismantling cylinder.

HANNIFIN

hydraulic cylinders proved best by drip-free test

Hannifin series "H" hydraulic cylinder with the only drip-free rod in the industry.

Select either "Step-Seal" piston rings (standard) for most applications or exclusive "LIPSEALS" where zero "clearance flow" is required.

No oil dripping on machine, product or floor proves complete sealing of oil within the cylinder by our removable, replaceable bronze cartridge gland with the exclusive "LIPSEAL"® and "WIPERSEAL" combination. (This new-type gland is shown close up at upper left.) This gland not only seals better, its long bearing surface is inside the seals where lubrication is assured.

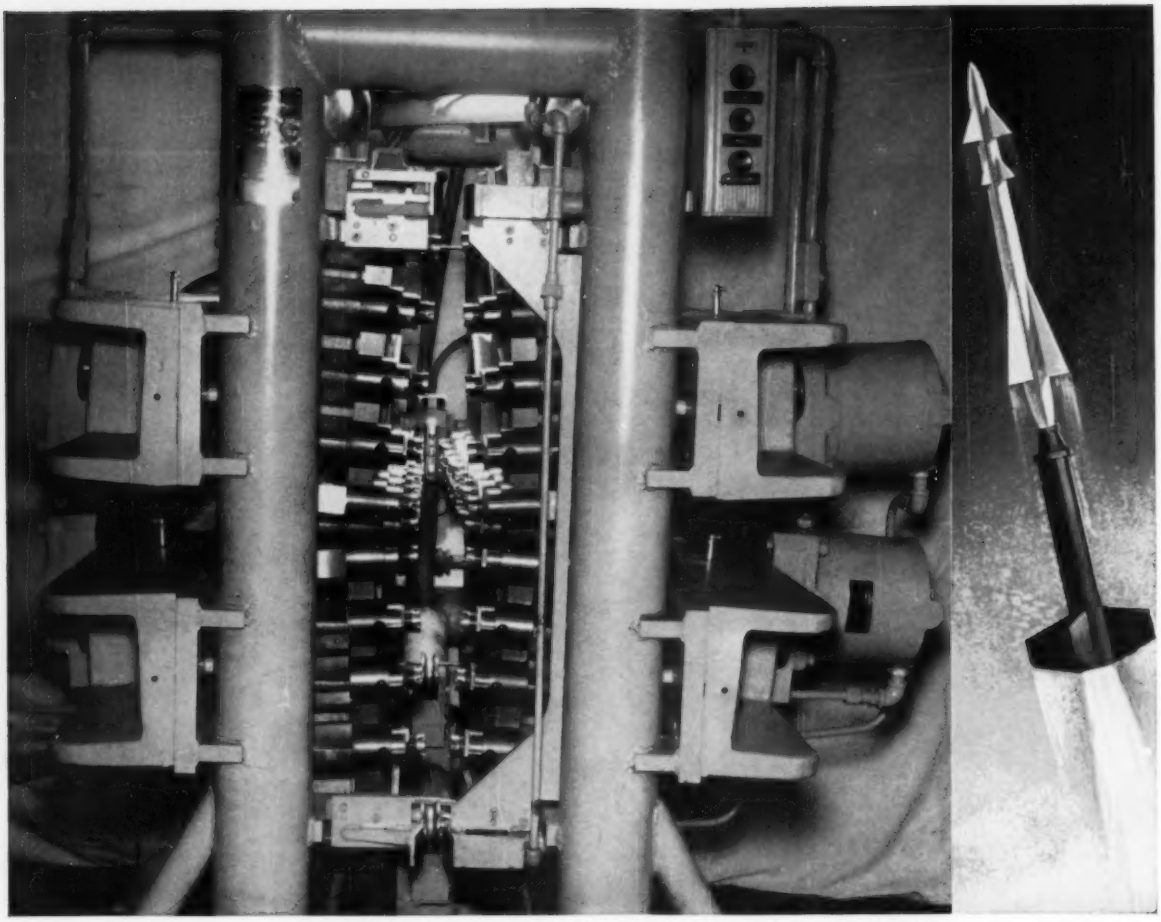
Other Hannifin cylinder features include ground and polished rods hardened to an extra-deep case, then hard-chrome plated and polished again; cylinder walls "Tru-Bored" straight and perfectly round *before* being honed... PLUS 48-hour delivery on most standard Hannifin cylinders whenever required.

Your nearest Hannifin sales office or representative is listed in the A-Z volume of Thomas' Register. Call us in when cylinders figure in your designs. Or, for cylinder literature, write:

HANNIFIN COMPANY

515 South Wolf Road • Des Plaines, Illinois

A DIVISION OF PARKER-HANNIFIN CORPORATION



Gardner-Denver air drills in special fixture drill holes for Nike fins.

Single air tool setup drills and countersinks 108 holes in 2 minutes

A PATTERN OF MULTIPLYING PRODUCTIVITY

A 100-year philosophy of growth—*there's no substitute for men*—has been confirmed again and again by Gardner-Denver air tool specialists. Their assistance in planning multiple screw driving, nut setting, and drilling setups has helped men in industry everywhere multiply productivity and cut costs.

One phase of fin fabrication for Nike missiles calls for drilling and countersinking 108 holes to exacting depths. Gardner-Denver air drills in this special fixture do the job in two minutes—automatically—at the touch of a button.

Multiple drilling problems, complex or simple, are easily solved with flexible Gardner-Denver air tools. Number of holes, different hole sizes, angles or drilling depths present no problem. A specially designed fixture with proper components from the Gardner-Denver air tool line can be engineered to fill every practical need.

Gardner-Denver can design and build you a complete special machine or we can work with your engineers to develop a fixture for your needs . . . help you select air tool components to meet exacting requirements. Get in touch with your Gardner-Denver air tool specialist soon.

GARDNER-DENVER Since 1859 — 100 1959 YEARS

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois
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Circle 678 on Page 147

Lost in the Shuffle

Pursuit of improved automatic manufacturing operations today is leading toward new and more sophisticated techniques. Attainment of realistic cost reductions with increasingly critical production demands calls for new perspective and an entirely new approach.

Experience has shown that automation has created the need for a new high-level approach to the manufacturing problem. For economic success there is no alternative. Nevertheless, industry invests relatively little in basic manufacturing research. The lion's share of research money goes into product development efforts. In addition, there is a distinct lack of personnel trained to design, manufacture, install, control, and maintain automatic production systems.

This critical function of manufacturing engineering will increase in importance. It is high time for adequate recognition. Commenting on the "Aeronautic Age" in the Harvard Business Review, Eliot Janeway hammered home this fact quite forcefully:

". . . industry is still concentrating on the competitive accumulation of premium research and development talent while underestimating its need of production engineering professionals . . . before industry can fully pay itself out on its investment in the last decade's crop of Ph.D.'s, it will have to concentrate for a very full decade on production engineering personnel, too. It will have to give this personnel more money as well as the perquisites that go with more money nowadays—status and security. In recent years, the kind of engineering skills that set up production and make it tick have tended to get lost in the shuffle between the scientists at one extreme and labor at the other. But production takes more than the smock-wearing corps and the overall-wearing team . . ."

From the standpoint of practicality and cost, manufacturing engineering for automation is a must. It is impractical to wait to study and analyze methods until after development of a complex processing system of any kind. The necessary series of processing steps must be devised, planned, and executed into equipment that is right the first time. Experience and know-how must be translated into a properly engineered automated system on a "before-the-fact" rather than "after-the-fact" basis.

Our rate of advance in the future will be linked directly to the manufacturing engineering function. Now is the time to organize and assure the advantages afforded by automation technology.

EDITOR

AUTOMATION

CREATING A TRANSFER MACHINE

Development of a multistation machine to automatically perform successive machining operations on a workpiece requires sound engineering before equipment is built. Engineering functions which must be performed are discussed by the author and illustrated by examples related to a particular machine.

By **ROBERT BREHM,** Chief Engineer, Snyder Corp., Detroit, Mich.

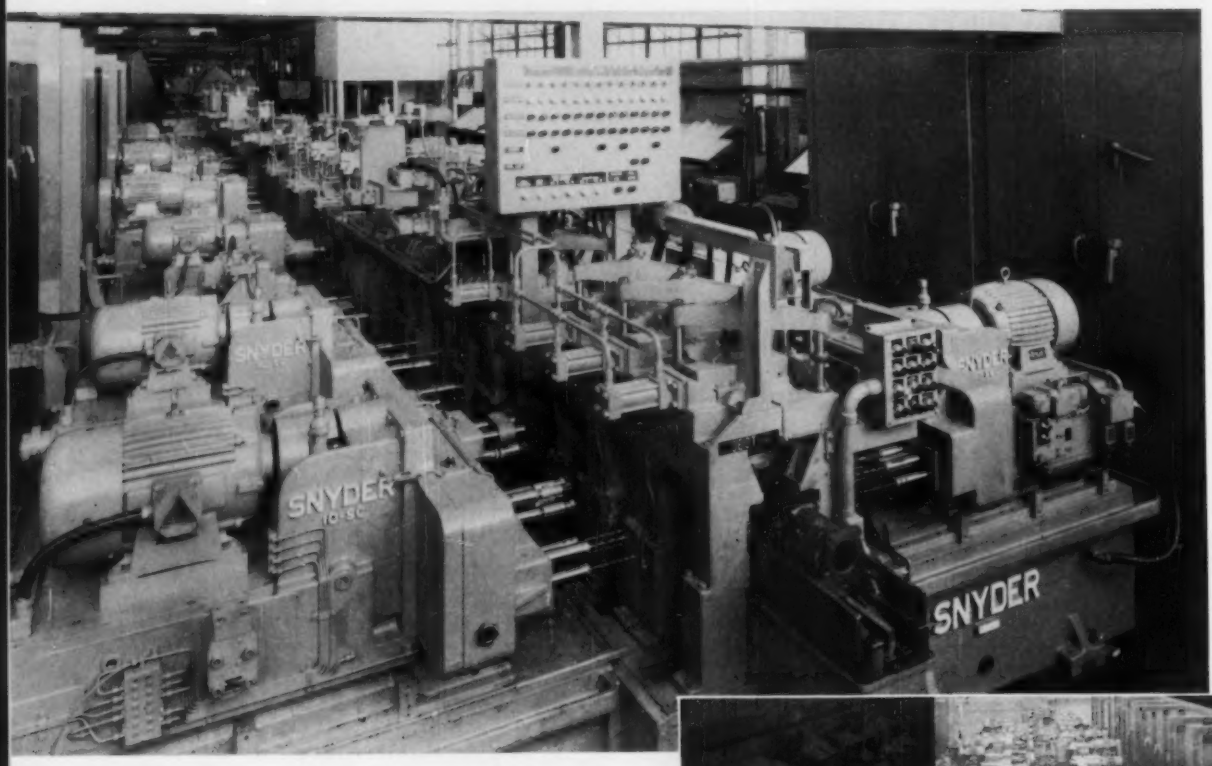


Fig. 1—Photos show a 53-station transfer machine composed of 13 segments. The machine can perform spotfacing, chamfering, reaming, line-reaming, tapping, milling, and boring operations on 80 cast iron automotive transmission cases per hour. The larger photograph is a view from the input end of the unit. A sample workpiece is resting on the transfer rails at the loading station. The troubleshooting light console is located so that a man at the master pushbutton station can readily determine trouble spots. The second photograph is a view from the discharge end of the machine. Pushbutton stations for individual segments can be seen. Segment controls are housed in the cabinets at right.

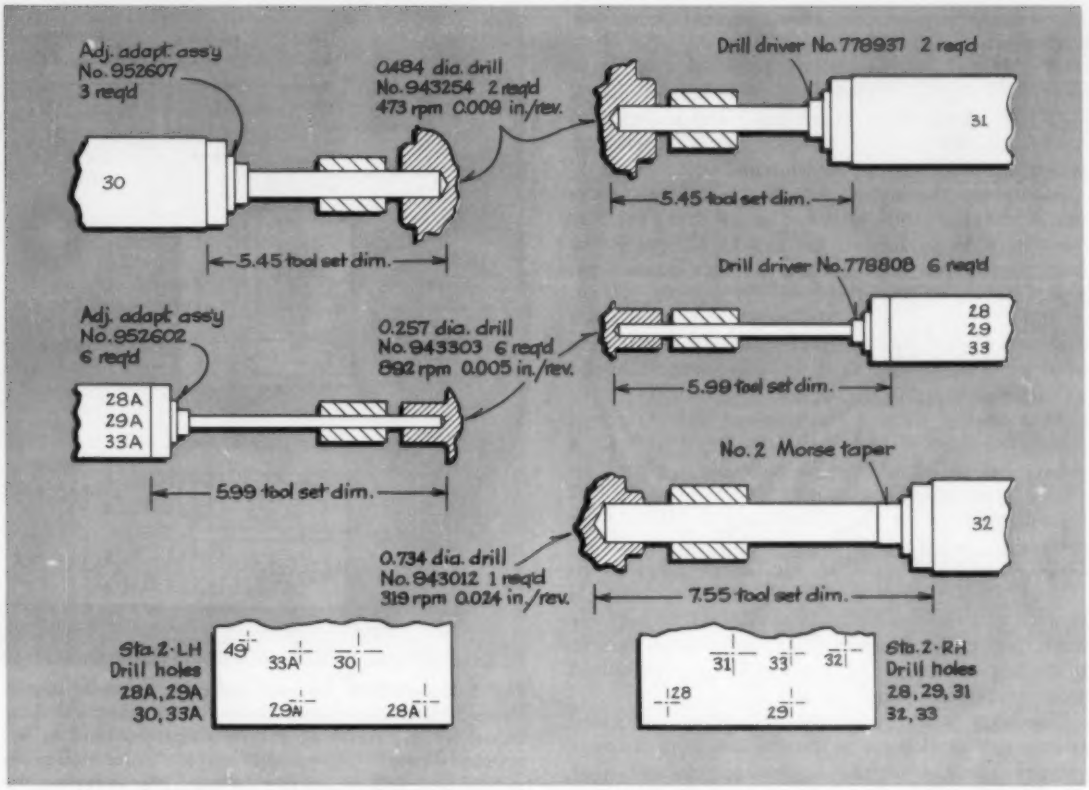


Fig. 2—First basic step in design of a transfer-type machine tool is preparation of tool and station layouts. This drawing presents the tool layout for the first machining station on the machine shown in *Fig.* 1. It records dimensions for different tools used at that station. Such tool layouts must also be prepared for any gaging stations required in the machine. To simplify tool changes, tools are designed to allow presetting.

TRANSFER-TYPE special machine tools in which parts are automatically transferred from one machining station to the next, *Fig.* 1, have become widely accepted by mass-production metalworking plants. The planning of such specialized types of automated machines is accomplished by applying a number of process engineering and design functions in an orderly sequence.

These functions are usually carried out in a relatively short period of time since they are done at the quotation stage. The final machine indicated by the processing and design sequence must be an educated guess of the highest order because a price commitment is made at the end of an intensive four to six-week study period. This short-time estimate requirement is one of the major reasons that have caused builders of special machines over the years to develop standard components (now called building blocks) having proved operating features and known design-and-build costs.

Seven basic steps are carried out in designing a transfer-type special machine tool. These are:

1. Tool and station layout.
2. Fixture layout.
3. Selection of transfer method.
4. Selection of machining units.
5. Head and base design.
6. Control system design (electrical and hydraulic).
7. Machine floor layout.

While the machine is being developed, two or more of the above steps are often carried out simultaneously to speed the estimating process.

Tool and Station Layout

The tool and station layout is based on three types of information furnished by the metalworking plant planning the transfer machine installation.

These include production rate, general processing method, and the part print. There are also often several factors on which the potential user indicates preferences. These may include tool usage, floor space limitations, motor types and makes, tool holders, in-process gaging requirements, lubrication systems, and control types and makes.

In making the layout, *Fig.* 2, the first consideration is the production rate. Let us say that a transfer machine is to produce at the rate of 120 pieces per hour at 100 per cent efficiency. This means that a part has to be produced every 30 seconds. Within this 30-second cycle, the part must be indexed into machining position, clamped, the machining head fed forward and back, and the part unclamped for the next transfer operation.

Most in-line transfer mechanisms move parts at rates from 8 to 12 inches per second, so at least a second has to be allowed for indexing. With a 2-second allowance for clamping and unclamping, 27 seconds remain for the machining function. The machining sequence is broken up into rapid advance, feed, and rapid return, which have to be accomplished within the 27-second time limit. It is often necessary to split up operations to meet the basic time cycle determined by the production rate. In such instances added machine length is required to accommodate added stations.

The number of operations that can be performed at any one station on a transfer machine depends upon the time available, the number of heads that can be utilized at the same time, and the horsepower capacity of the heads used. It is theoretically possible to machine three faces of a part simultaneously on conventional transfer machines, the top face and a face at 90 degrees on each side, do not interfere. It may also be possible to machine an additional surface or two at some other angle along with these other operations.

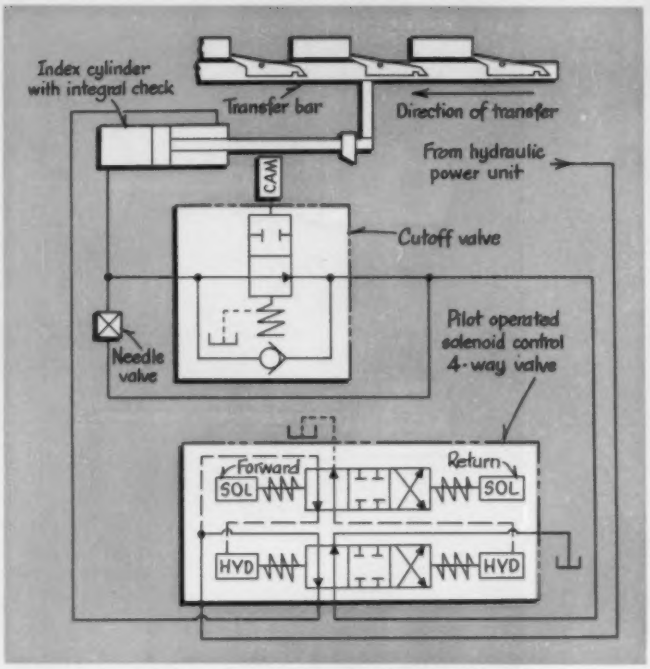


Fig. 4—Selection of transfer method is the third step in design. Simplest transfer method is the pawl-type illustrated by this sketch of such a mechanism and its hydraulic system. Workpieces are slid from station to station by pawls on the transfer bar. For indexing, the *Forward* solenoid is energized. This directs flow from the pump to the front of the cylinder, causing the transfer bar to advance. When a forward limit switch has been tripped, the *Return* solenoid is energized, directing flow to the rear of the cylinder; and the transfer bar returns to position for another index. The transmission case machine uses a pawl-type transfer.

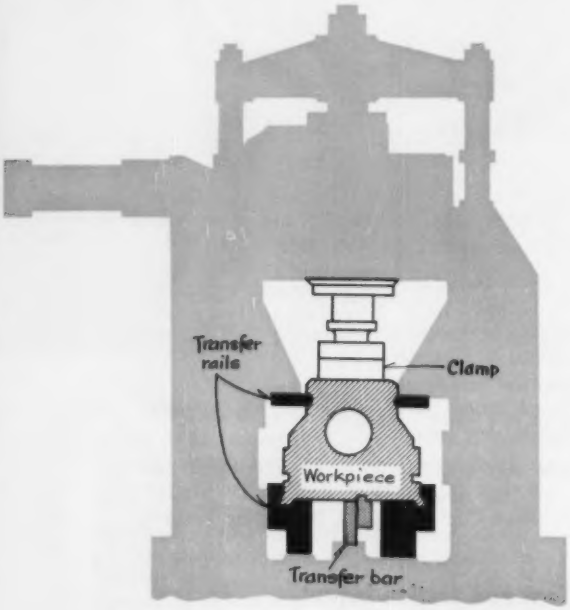


Fig. 3—Second step in transfer machine design is fixture layout. Shown here is a layout indicating the fixture arrangement used in the first segment of the transmission case machine.

The trend in transfer machines today is toward ease of maintenance and tool change. This limits the number of machining units which can be crowded around a single station position. The segmented concept is applied. In this concept, each station is in reality a separate machining unit with individual controls and operating functions. This unit is sequenced into the over-all machine, and transfer mechanisms move the parts between unit positions generously spaced with idle stations.

Operations usually performed in combination on transfer machines are of the milling, drilling, and boring types, but performing of certain gaging functions between machining operations considerably increases the utility of transfer machines. Probing stations for locating incompletely drilled holes, broken taps, and incompletely milled surfaces make good sense in transfer lines because they can shut down the machine quickly before too many bad parts are produced. Furthermore, such shutdowns

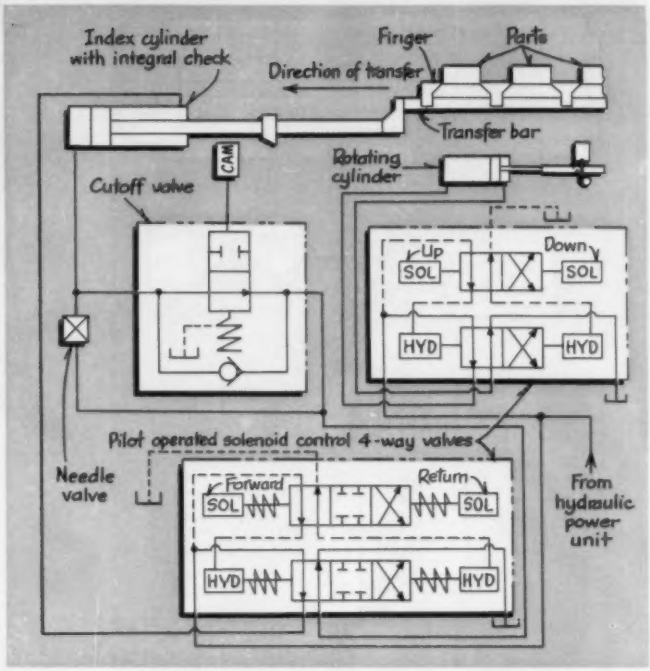


Fig. 5—Rotating transfer bar with fingers is a second popular transfer mechanism. As shown in this drawing of such an arrangement, two cylinders are used; one to reciprocate the transfer bar, and the other to rotate it and move the fingers in or out of engagement with the work. During indexing, the *Up* and *Forward* solenoids are energized to direct fluid from the pump to the front of the *Index* cylinder and to the rear of the *Rotating* cylinder. This causes the bar to advance with the fingers in engagement with the part. *Down* solenoid is energized and causes flow of fluid to be directed to the front of the *Rotating* cylinder. The fingers swing down and the *Return* solenoid is energized to direct fluid to the rear of the *Indexing* cylinder. The transfer bar retracts and the *Up* solenoid is energized to raise the fingers for the next index when the machining cycle is completed.

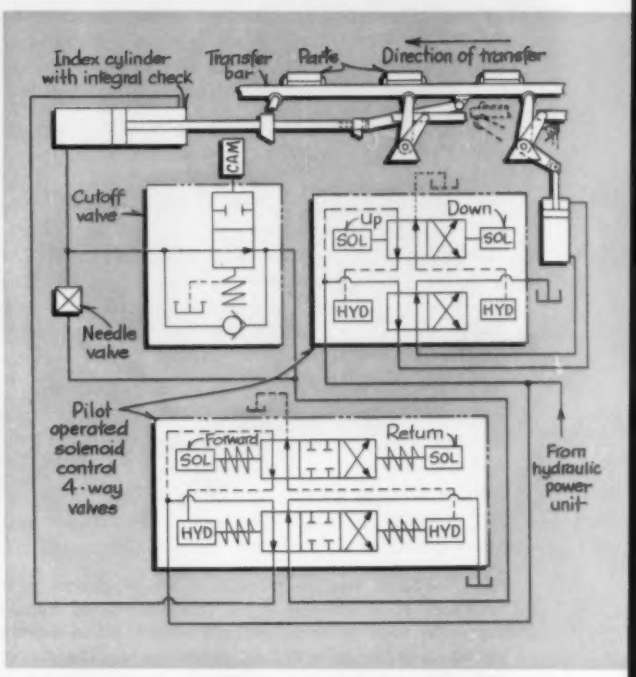


Fig. 6—Walking beam transfer mechanism is another popular transfer method. Two cylinders are also used in this type; one to raise and lower the transfer bar and workpieces, the other to reciprocate the transfer bar. The transfer cycle is initiated by first energizing the *Up* solenoid to raise the transfer bar. During transfer, the *Up* and *Forward* solenoids are energized. This directs flow of fluid from the pump in the hydraulic unit to the top of the *Elevating* cylinder and the front of the *Indexing* cylinder. The bar is held in raised position while the *Indexing* cylinder reaches the end of its travel, the *Down* solenoid is energized, directing flow of fluid to the bottom of the *Elevating* cylinder and lowering the transfer bar. Then the *Return* solenoid is energized, directing flow of fluid to the rear of the *Indexing* cylinder, and the index bar retracts.

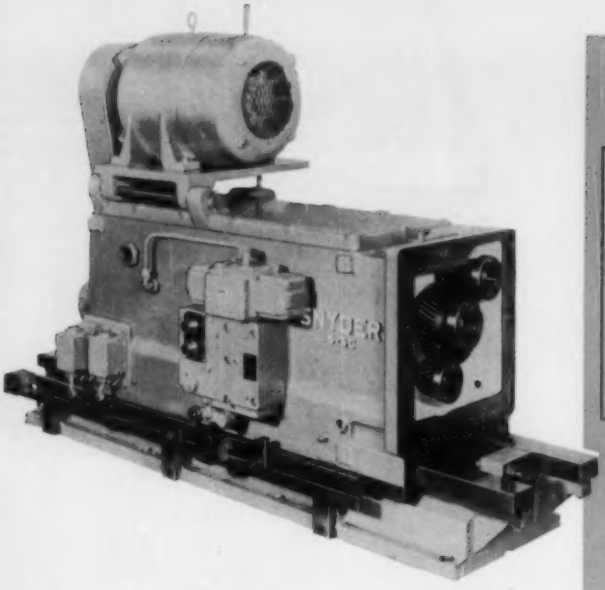
avoid further tool breakage due to excessive loading conditions. If precision machining operations are performed on a transfer machine, it is also sound practice to gage them in the succeeding station before a quantity of parts is produced that has to be salvaged or completely rejected. Initial tool layouts, then, must include any gaging stations at the beginning of the machine design.

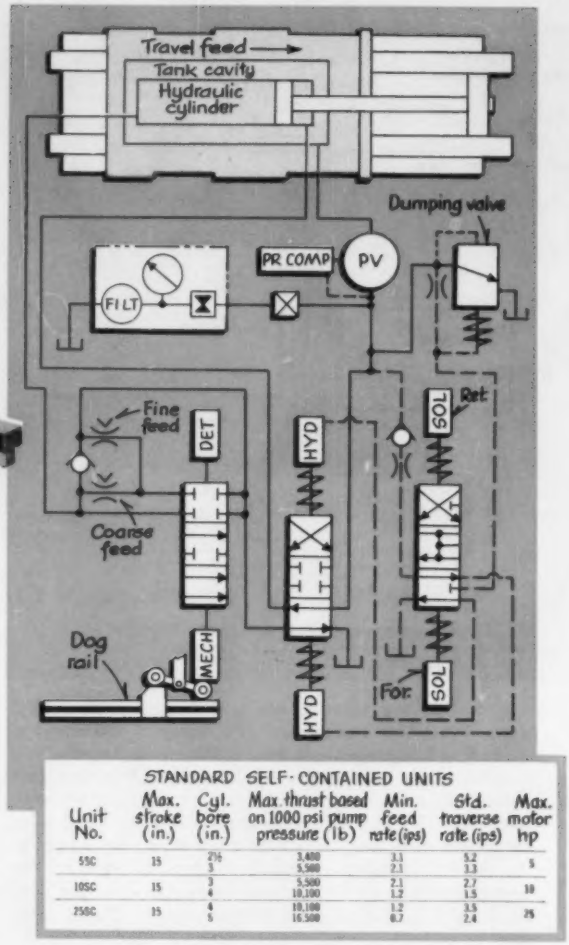
Maximum efficiency in transfer machines is achieved by performing as many workpiece operations as possible within a single machine. As stated previously, three sides of a part can theoretically be machined on a transfer machine along with several angular surfaces without considering part orienting within the transfer line. But where the ends and bottom of the part can be machined in a transfer line, the addition of orienting units between machining station groups is a feasible concept.

Part orienting or turnover devices must be foolproof in their design and operate in timed sequence with the transfer mechanism. Adequate room for such mechanisms should be provided to allow for maintenance and service functions. Usually these orienting mechanisms are made in segmented designs like the machining stations. This feature provides for maximum amount of flexibility within the transfer machine for future design changes.

In the particular piece of equipment shown in *Fig.* 1, the machine had some vertical machining units as originally conceived. Although vertical machining units may cut cost of transfer machines, many users prefer machines with all machining units horizontal to permit simultaneous machining from opposite sides. Horizontal units also are more accessible and easier to service according to some user reports. To allow the use of all horizontal units on this machine, operations were rearranged. Vertical units were thus eliminated from this design.

The operating stations of this machine were combined into 13 machine segments, and included





STANDARD SELF-CONTAINED UNITS

Unit No.	Max. stroke (in.)	Cyl. bore (in.)	Max thrust based on 1000 psi pump pressure (lb)	Min. feed rate (ips)	Std. traverse rate (ips)	Max. motor hp
5SC	15	2½ 3	3,400 5,500	3.1 2.1	5.2 3.3	5
10SC	15	3 4	5,500 10,100	2.1 1.2	2.7 1.5	10
25SC	15	4 5	10,100 16,500	1.2 0.7	3.5 2.4	25

Fig. 7—Fourth step in transfer machine design is the selection of machining units. Self-contained machining units, such as those indicated here, avoid external piping to separate hydraulic power units. The element that slides on the ways contains its own hydraulic reservoir, pump, drive motor, and control valves.

three in-process gaging devices that probe drilled holes to check for through-drilling before tapping. The part is located for machining and transferred on faces that have been determined as not subject to design changes. This decision prolongs the design life of the machine and simplifies machine alterations that may be required for anticipated part changes.

▶ Fixture Layout

The basic key to the success of a transfer machining operation is the method of fixturing. The fixturing method determines station spacing in a transfer machine. Such complicated parts as automotive engine intake and exhaust manifolds require extensive design study to find the best workable method of fixturing. Often wood models of these parts are made to help the machine designer choose the best fixture design. The method of fixturing depends on the distance the part must travel, and the size and weight of the part. Fixturing of parts in transfer machines is done in two ways.

One way (and the least expensive way) is to move the parts in an unclamped condition from station to station with one of several types of transfer mechanisms. At the machining stations, fixed or disappearing-type dowel locators and hydraulically-actuated fixture clamps hold the parts. Fixture arrangement for the first segment of the machine in *Fig.* 1 is shown in *Fig.* 3. If the parts are held in identical positions in each machining station in accordance with the manner in which they will be bolted in the final assembly, the effects of stresses and distortion due to heavy metal removal will not present a problem.

Where parts are of such a shape that it is virtually impossible to utilize the free-transfer and station-clamping method, palletized fixtures in which parts are individually clamped are an alternate fixturing method. A large number of fixtures are required for the palletized method. These fixtures are moved by a transfer mechanism from station to station.

The palletized transfer machine has several obvious disadvantages. Fixture cost is extremely high. Washing operations are required to flush chips from the pallets before they are reloaded. Means for periodically lubricating the working mechanism of the pallets must also be provided. Usually, clamping of the parts in pallet fixtures is a complex, time-consuming operation. Thus, pallet fixtures should be considered on transfer machines only when there is no alternative fixturing method.

▶ Selection of Transfer Method

After the fixturing method is selected, the next step in transfer machine creation is the selection of

the transfer method. Parts or parts and fixtures are usually moved in a straight line from station to station on transfer machines by means of hydraulically actuated transfer bars. The type of transfer bar arrangement used depends upon the type of part being machined and the manner in which it should be transferred. Hydraulic cylinders powered by packaged hydraulic power units actuate the various types of transfer bar mechanisms.

Three general transfer bar designs have been used successfully in transfer machine tools. These are the pawl-type, the rotating-bar-with-fingers, and the walking-beam designs. The pawl type provides an adequate method if the part has good sliding surfaces. A rotating bar with fingers can be employed on parts with shallow sections. The walking-beam method requires deep fixture-clearance areas in the machining stations. Both of the latter types of transfer mechanisms can trap the part to avoid overtravel at the machining station.

Pawl-Type Transfer Mechanism: The most simple and inexpensive type of transfer mechanism is the pawl type, *Fig.* 4, in which the parts are slid from one machining station to the next. The transfer bar is advanced and retracted with a linear reciprocating motion by an index cylinder. As the bar retracts, the spring or gravity-loaded pawls slide under the parts. A cushion in the index cylinder and a cutoff valve and cam provide deceleration characteristics on the forward and return strokes. The cutoff valve provides deceleration features that avoid overtravel of parts.

Rotating Bar With Fingers: Where parts are to be trapped, a transfer bar with fixed fingers is used, *Fig.* 5. This bar has fingers attached to it and is rotated by a separate hydraulic cylinder in addition to the hydraulic cylinder that reciprocates the bar. Each part is trapped to completely avoid part overshooting of the machining station. Operation of this system is identical with the pawl-type bar index system with the addition of the rotating controls. A cushion in the index cylinder provides the deceleration feature on the return stroke. A cutoff valve acts similarly when the transfer bar is advanced.

Walking Beam Transfer Mechanism: Positive movement of parts from station to station without sliding, in transfer-type special machine tools, is provided by the walking-beam type of transfer bar mechanism, *Fig.* 6. In this design the transfer bar is elevated by a separate hydraulic cylinder through a linkage. This action lifts the parts. The bar is advanced by the index cylinder, moving the parts to the next station. Then the elevating cylinder lowers the bar to place the parts in the advanced position, and the transfer bar retracts. In this type

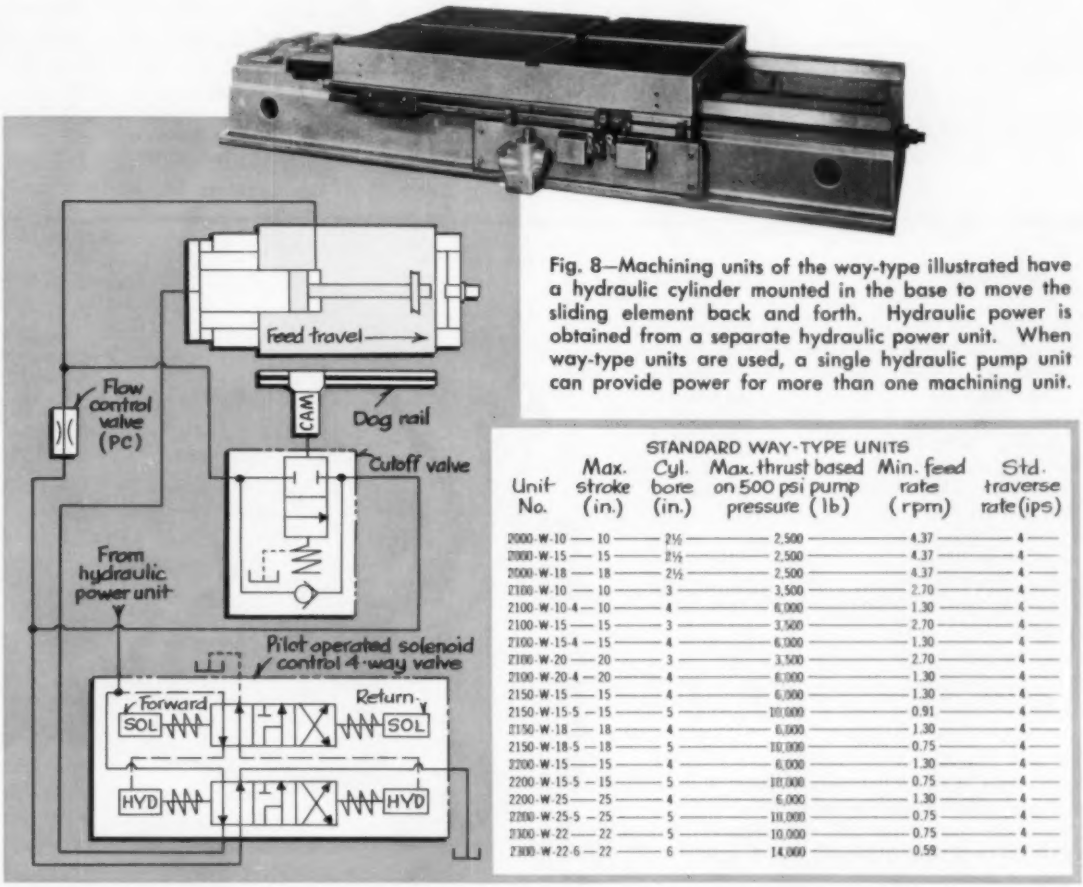


Fig. 8—Machining units of the way-type illustrated have a hydraulic cylinder mounted in the base to move the sliding element back and forth. Hydraulic power is obtained from a separate hydraulic power unit. When way-type units are used, a single hydraulic pump unit can provide power for more than one machining unit.

STANDARD WAY-TYPE UNITS

Unit No.	Max. stroke (in.)	Cyl. bore (in.)	Max. thrust based on 500 psi pump pressure (lb)	Min. feed rate (rpm)	Std. traverse rate (ips)
2000-W-10	10	2½	2,500	4.37	4
2000-W-15	15	2½	2,500	4.37	4
2000-W-18	18	2½	2,500	4.37	4
2100-W-10	10	3	3,500	2.70	4
2100-W-10-4	10	4	6,000	1.30	4
2100-W-15	15	3	3,500	2.70	4
2100-W-15-4	15	4	6,000	1.30	4
2100-W-20	20	3	3,500	2.70	4
2100-W-20-4	20	4	6,000	1.30	4
2150-W-15	15	4	6,000	1.30	4
2150-W-15-5	15	5	10,000	0.91	4
2150-W-18	18	4	6,000	1.30	4
2150-W-18-5	18	5	10,000	0.75	4
2200-W-15	15	4	6,000	1.30	4
2200-W-15-5	15	5	10,000	0.75	4
2200-W-25	25	4	6,000	1.30	4
2200-W-25-5	25	5	10,000	0.75	4
2300-W-22	22	5	10,000	0.75	4
2300-W-22-6	22	6	14,000	0.59	4

of transfer mechanism also, a cushion in the index cylinder and a cutoff valve provide decelerating features for bar advance and retract motions.

▶ Selection of Machining Units

After the tool layout, fixture layout, and transfer methods have been selected and integrated, the individual machining units at the various stations can be selected. The tool layouts provide sufficient design information to calculate head horsepower and cylinder size based on thrust load, spindle torque, and feed rate specifications. As stated previously, transfer machine builders have developed, over the years, lines of standard machining units that suit a range of machining operations on special machine tools including rotary index, line index, center column, trunnion-type, and transfer-type machine tools. These units are electrically controlled, hydraulically actuated, and available in several basic designs.

Two typical designs of machining units often used on transfer machine tools are the self-contained and way-types. The self-contained type is compact, has a small amount of piping, has a low manufacturing cost, and is usually adequately designed to operate other power units such as fixture clamps and probe controls. Way-type units, which include a head drive and initial gear reduction unit,

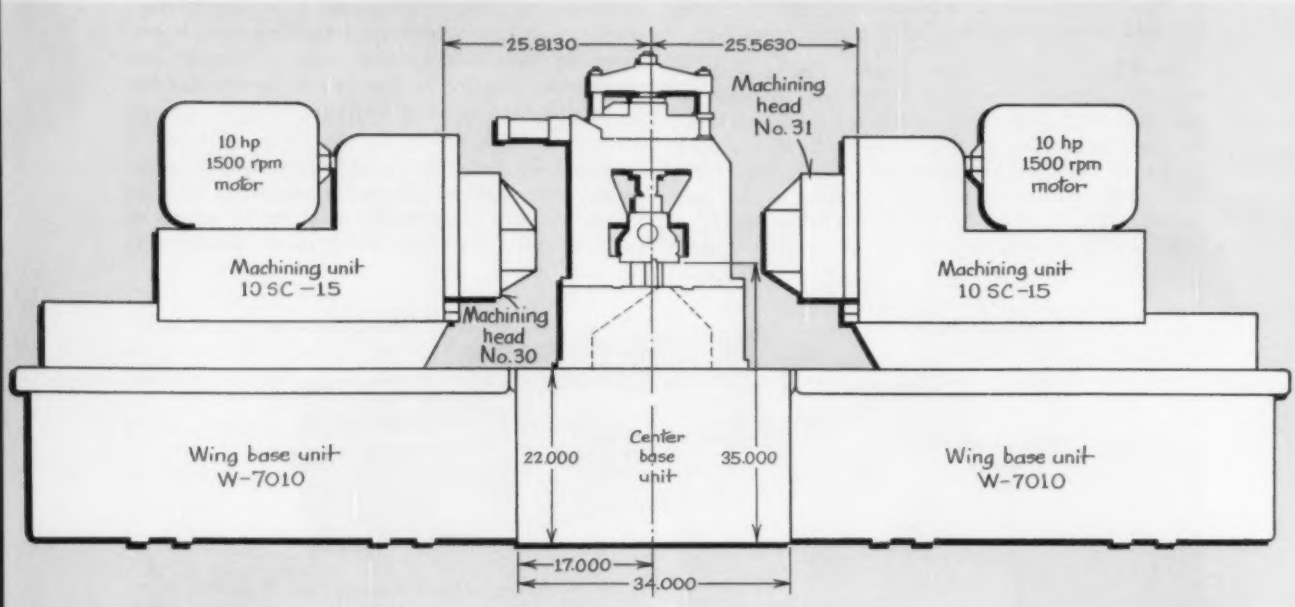


Fig. 9—Head and base design follows selection of machining units. This sketch gives head and base information for the first segment of the transmission case machine. This segment includes a standard center section, that supports the fixtures, and standard wing bases that support standard machining units on each side of the line. A unique bushing plate assembly was provided for the line reaming operations at Station 30 of the transmission case machine. The assembly enters the workpiece through a relatively small hole. After the assembly is positioned, arms extend bushings into correct position for the line reaming operation.

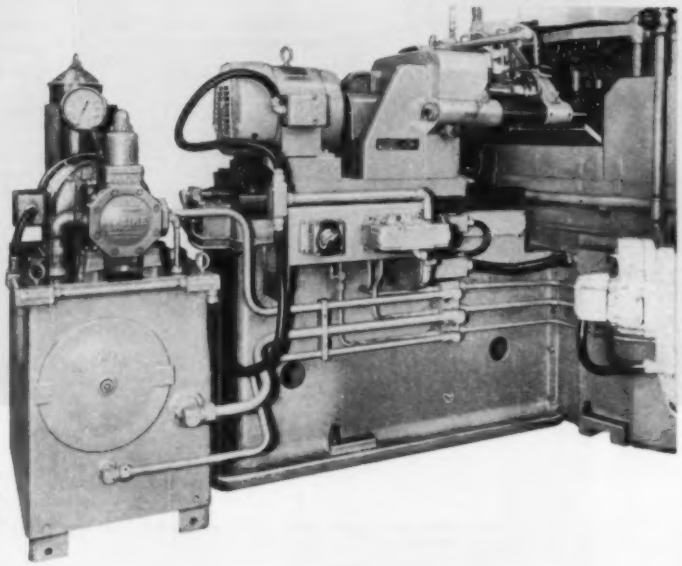


Fig. 10—Partial view of a typical transfer machine segment shows part of the center section, wing section, and way-type machining unit with machining heads. At left is the separate hydraulic power unit.

receive their hydraulic power from a separate hydraulic power unit. Several units and auxiliary machine functions can be operated from a single hydraulic power source. The following descriptions cover details of typical design features of these two types of units.

Self-Contained Machining Units: The machining units of the type shown in *Fig.* 7, do not require separate hydraulic pump and tank units and related external piping. They have a cast iron base that is provided with replaceable, hardened and ground steel ways. The unit that slides on the ways is basically a hydraulic tank cavity mounting a hydraulic cylinder that advances and retracts the unit. The integral hydraulic pump and the spindle drive shaft with a built-in primary gear reduction are driven by an electric motor mounted on the head of the unit. Drill heads, boring heads, and related machine components are bolted to the front of the unit and driven by the motor.

All hydraulic control components including valves, control panels, and stops are mounted on the side of the unit. The pump, traverse and feed panel, dumping valve, and cylinder are manifold-mounted to facilitate maintenance. The unit can be short-stroked for any portion of the full stroke to decrease traverse time. Pump output is discharged to the tank under no pressure when the unit is idle, thereby allowing minimum temperature rise. The pump is of the variable volume, constant-pressure type and delivers only the horsepower demanded by the system, thus generating a minimum amount of heat in the fluid.

An external pressure line can be provided from the pump to operate clamps or similar functions. With this feature, the dumping is governed by the pilot valve on the outside device rather than the pilot spool of the traverse and feed panel. For special applications, the unit can be sequenced to feed in both directions.

Way-Type Machining Units: Units of the type shown in *Fig.* 8 have a cast-iron base with removable hardened and ground steel ways. The top of each unit is keyed in two directions for the mounting of a motor and a head unit with initial gear reduction. A hydraulic cylinder that moves the slide back and forth is mounted in the base.

These way-type units have a removable cylinder and cam-operated feed valve. The feed valve is mounted close to the unit proper to assure positive feed. Use of a spring-centered 4-way valve permits short-stroking and saves cycle time. Full stroke is available for ease of tool change. The cylinder bleed line is piped to a convenient location. A cylinder of adequate size must be provided to assure a large flow through the metering device and a resultant smooth feed.

Hydraulic power for operating standard way-type units is provided by a separate motor, pump, and tank unit that is piped to the control panel mounted on the side of the way-type unit. One or more way-type machining units can be operated by a single hydraulic power unit. These power units have a variable-volume, pressure-compensated, vane-

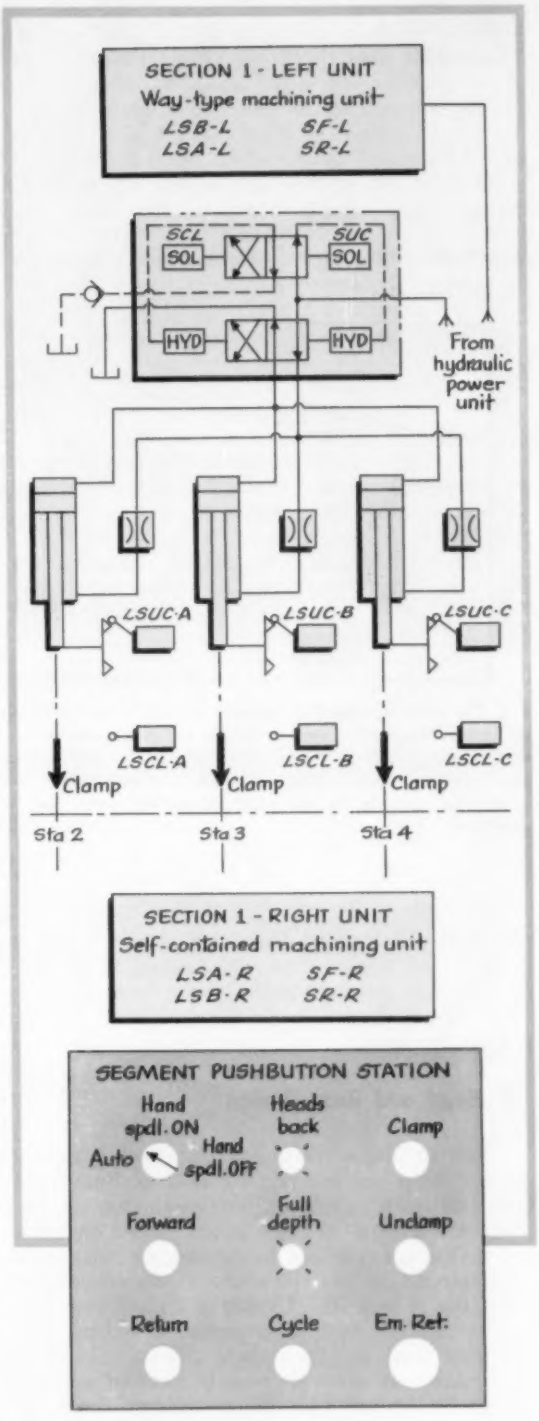


Fig. 11—Sixth step in design of a transfer-type machine tool is the determining of control systems. For a segmented-type machine, each segment has its own controls. The hydraulic diagrams shown are for the first segment of the transmission case machine. This segment has two identical pushbutton operating stations for control of the segment. Part clamping, machining, and unclamping can be independently controlled for each segment to aid setup and repair operations.

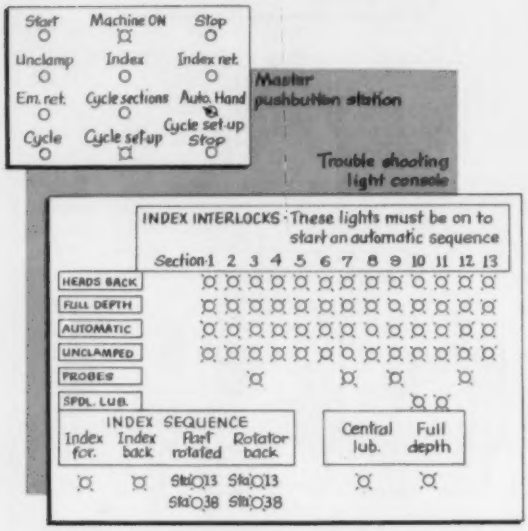


Fig. 12—After the control systems for each segment are designed, the control system for the complete machine is developed. A master operating station for the entire machine is provided, and to readily indicate sources of operating trouble, a troubleshooting light console is specified.

type hydraulic pump. Flow of fluid is at constant pressure and governed by the demand of the system. When pressure in the power unit filter exceeds 50 psi, fluid flows to the tank automatically without filtration.

Head and Base Design

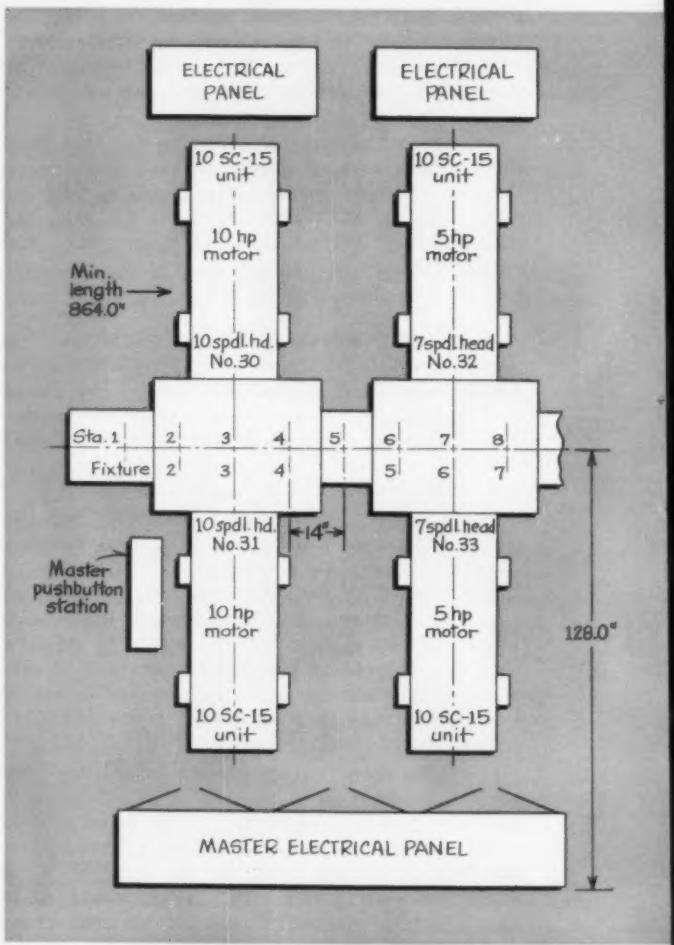
Heads for the standard building block type machining units are individually tailored from head design standards to meet the machining requirements indicated on the tool layout. Bases of standard design are provided to support the machining units selected for the operations at the various stations, *Fig.* 9 and 10. Usually a typical base unit consists of a standard center section to which standard wing bases or column bases are bolted. Way-type machining units are usually specified as vertical machining units for use on column bases because they are lighter in over-all weight than self-contained units. Tapping heads of standard design are usually mounted on a way-type machining unit.

Control System Design

With all machining units, station spacing, and operation sequences planned, the control system for the over-all machine can be determined. To meet the high efficiency and design flexibility demanded by modern mass-production metalworking plants, complex control systems are provided for transfer machines. Although original transfer machine designs utilized the single base and single control panel concepts, and later designs the sectionalized base and section control panel concepts, the modern design has dictated the segmented base concept with individual controls for machining units and with wide spacing between units. This new concept has considerably simplified maintenance and servicing procedures as well as added great flexibility for future design changes. But it has also added much control design time and control component cost to the transfer machine.

With the segmented concept, each machining unit has its own controls, *Fig.* 11. This means that it has separate pushbutton and pilot light indicators for each machining unit function, fixture clamping, etc., along with a separate control panel. Thus, the control system for each segment is developed in this phase of machine creation.

When the control system for each segment is



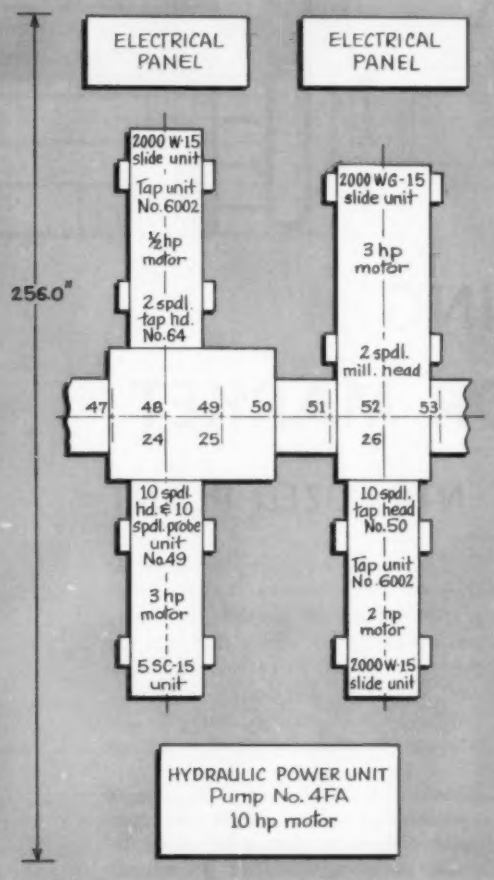
completed, the control system for the entire machine is developed. For this system there is a compact main control panel and a master pushbutton control panel with a generous assortment of pushbutton and indicator light controls, *Fig.* 12. When such control systems are designed, much emphasis is put on ease of troubleshooting. Adequate foolproofing of a machine means not only shutting down the machine when trouble or out-of-size parts are encountered, but also quick indication of the reason for the shutdown and quick location of the trouble source.

To meet all of these foolproofing requirements, it is also necessary to provide, within the control panels themselves, adequate means for simplifying troubleshooting procedures. Additional terminal strips of varying types within the control panels help significantly in panel troubleshooting.

▶ Machine Floor Layout

A final machine floor layout, complete with floor space dimensions, unit designations, operation descriptions and station numbers, represents the final step in the planning of the transfer machine. It can only be made after all of the previous six design functions have been carried out. Upon this creation, *Fig.* 13, is based the estimate of the machine tool builder. If he receives an order for the machine, the design program for the detailing of the components for the machining units, transfer mechanism, and control system is initiated. A large purchasing program for procuring the myriad of standard components that go into the drive and control system for the machine is also begun. A build and assembly program for various machine components is put into motion along with patternmaking and casting construction as soon as the various unit designs clear the checker's desk.

A modern transfer-type special machine tool is a creation that is the result of a planned program of design, procurement, construction, assembly and tryout. Proper planning and design form the foundation upon which all other phases of the development depend. It is no accident that these machine tools have become so widely accepted by the mass production metalworking industry.



OPERATIONS

Sta.-1-Load

Sta.-2—RH—Drill - 28, 29, 31, 32, 33
LH—Drill - 28A, 29A, 30A, 33A

Sta.-3—RH—S'face - 28, 29, 33 Rgh c'bore - 31
LH—S'face - 28A, 29A, 33A Rgh c'bore - 30

Sta.-4—RH—S'face and chamf. - 31
LH—S'face and chamf. - 30 Drill - 49

Sta.-5-Vacant

Sta.-6—RH—Chamf. - 28, 29, 32, 33 Semi-fin. c'bore - 31
LH—Chamf. - 28A, 29A, 33A Semi-fin. c'bore - 30

Sta.-7—RH—Fin. ream - 31
LH—Fin. ream - 30 Ream - 49

Sta.-8—RH—Fin. ream - 31
LH—Fin. ream - 30

Sta. 47-Vacant

Sta. 48—RH—Chamf - 34, 35, 36, 37, 38, 39, 40, 41, 42, 43
LH—Tap - 11, 12

Sta. 49—RH—Probe - 34, 35, 36, 37, 38, 39, 40, 41, 42, 43

Sta. 50-Vacant

Sta. 51-Vacant

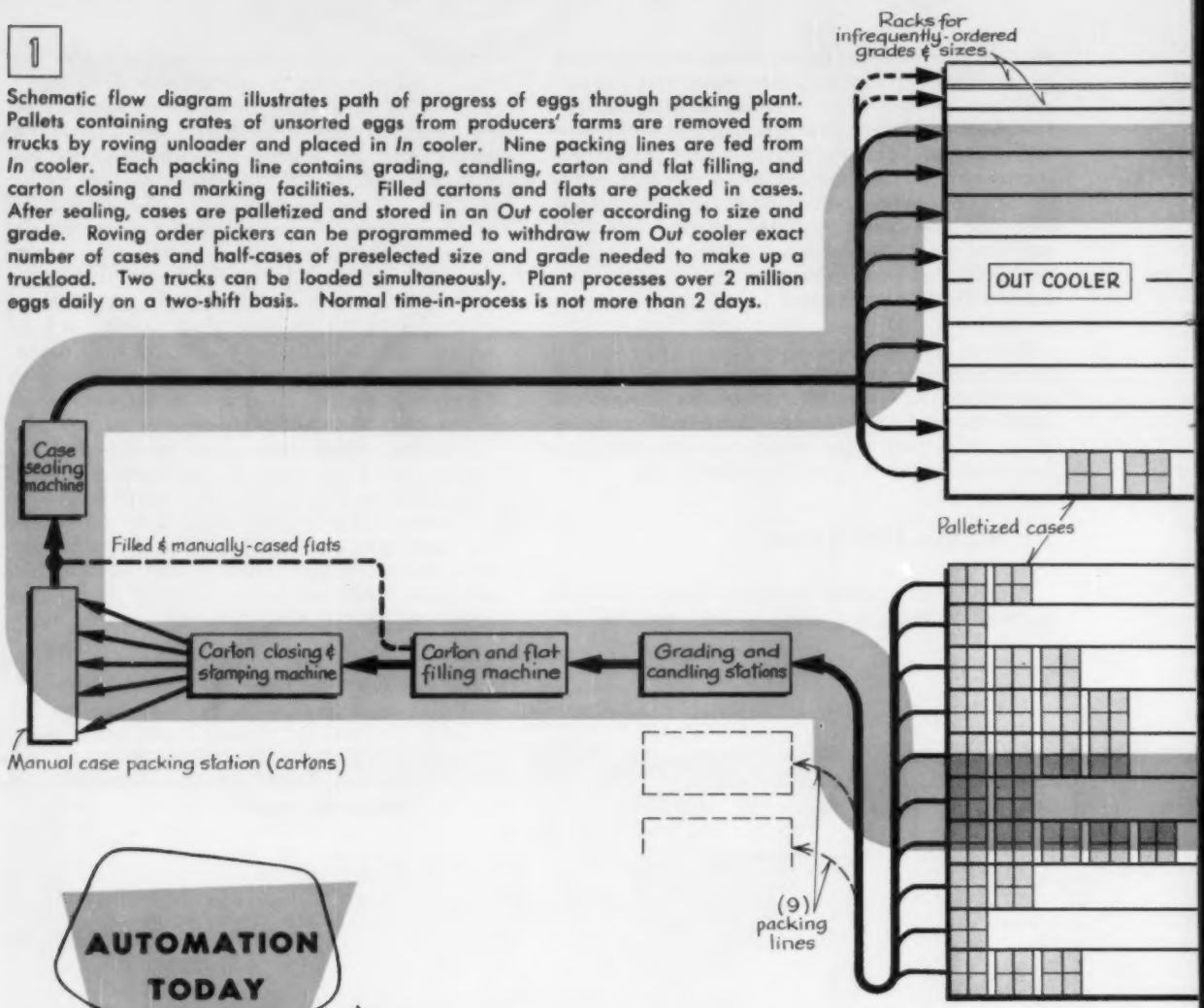
Sta. 52—RH—Tap - 34, 35, 36, 37, 38, 39, 40, 41, 42, 43
LH—Mill inside of flanges at 2 and 3

Sta. 53-Unload

Fig. 13—Machine floor layout represents the final step in planning of a transfer machine. This drawing presents part of the floor layout of the 53-station transmission case machine. Such a layout can be expected to show floor space dimensions, unit designations, operation descriptions, and station numbers. The cost estimate of the machine builder relies heavily on this layout.

1

Schematic flow diagram illustrates path of progress of eggs through packing plant. Pallets containing crates of unsorted eggs from producers' farms are removed from trucks by roving unloader and placed in *In* cooler. Nine packing lines are fed from *In* cooler. Each packing line contains grading, candling, carton and flat filling, and carton closing and marking facilities. Filled cartons and flats are packed in cases. After sealing, cases are palletized and stored in an *Out* cooler according to size and grade. Roving order pickers can be programmed to withdraw from *Out* cooler exact number of cases and half-cases of preselected size and grade needed to make up a truckload. Two trucks can be loaded simultaneously. Plant processes over 2 million eggs daily on a two-shift basis. Normal time-in-process is not more than 2 days.



AUTOMATION TODAY

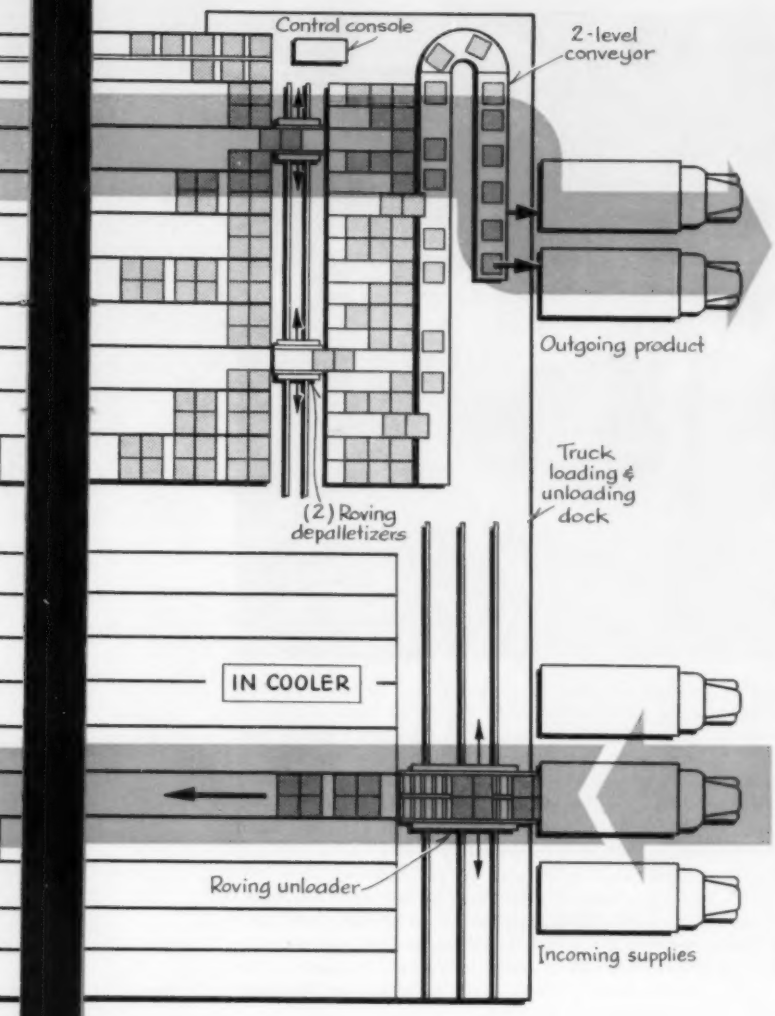
PREPARING EGGS FOR MARKET

IN LARGE-SCALE CENTRALIZED PLANT

PROGRESS in packing of unprocessed foods such as produce and animal or poultry products, has generally lagged behind the advances shown in the food processing industries. Three primary factors have been responsible for this lag: 1. The necessity for manual inspection of each individual unit. 2. The requirement of grading each unit by size, weight, color and configuration. 3. The complication of avoiding damage in the face of extreme product fragility. This has been especially true in handling such foods as leafy vegetables, soft fruits, berries, and eggs.

Egg handling and packing, for example, is usually strictly a manual operation in which the eggs are inspected, weighed, and placed in cartons and cases by hand. They are then transferred manually through the various steps of sealing, marking, and storage until they are placed in trucks at a loading platform.

Poultry Producers of Central California, one of the largest egg producing co-operatives in the country, was faced with a dual problem when they decided to modernize their egg packing procedures. Not only did they have a completely manual oper-



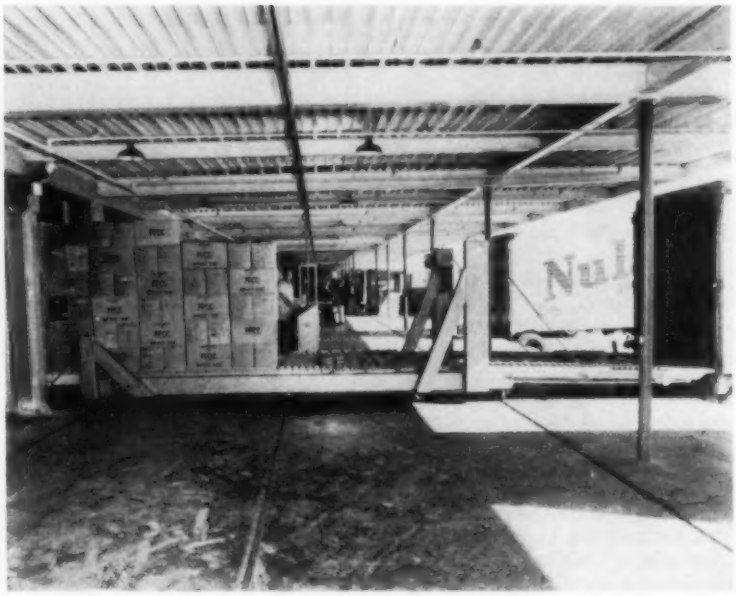
ation, but it was scattered in many district packing plants, which greatly increased overhead and complicated distribution. As a first step in modernization, they developed equipment to automate the grading, weighing, and packing functions (See AUTOMATION, Dec. 1954).

An automated plant, centrally located in San Leandro, is the co-op's more complete solution to both packing modernization and distribution problems. In this plant, facilities have been provided to efficiently handle the eggs to and from packing lines. Nine automatic packing lines turn out a total of 2,160,000 eggs each double-shift day.

This high volume of fragile product is handled mechanically with an almost insignificant loss from breakage (0.1 per cent). In fact, the system has enabled management to pinpoint the sources of breakage that does occur, an impossible task under former hand operations. With each step of the packing and inspection process closely controlled, the main source of breakage was discovered to be shipping.

Eggs arrive at the plant in refrigerated trucks. The trucks are equipped with roller beds and contain crates of unsorted eggs on pallets. The pallets are automatically removed by an operator-controlled roving unloader which connects directly to roller conveyors in an *In* cooler. An interesting feature of the covered unloading-loading dock is that the entire area is refrigerated, even though it is open to the outside air. A blanket of cool air prevents undesirable temperature rises in the eggs while they are being handled.

From the cooler, the eggs are transferred by fork lift truck to inspection and grading areas for each line. There, operators remove the eggs from the shipping cases, examine them before intense lights which permit visual inspection of the interiors (can-



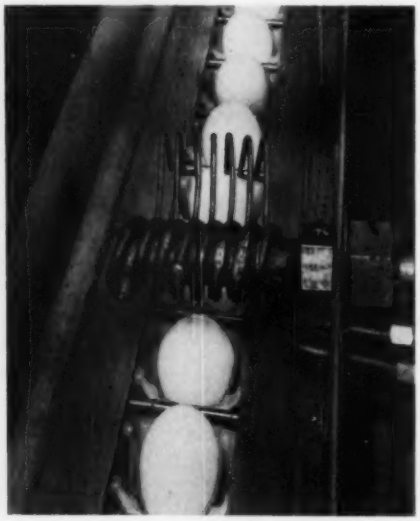
2

Refrigerated trucks pick up ungraded and unsorted eggs from producers' farms and deliver them to unloading dock. Each truck is equipped with a roller bed, and egg crates are stacked on pallets. A roving unloader, which runs on tracks set in the dock floor, withdraws pallets from the trucks and rolls them into the *In* cooler to await candling, grading, and packing. The entire covered dock area is blanketed with refrigerated air to prevent temperature rise in the eggs during unloading.

3 Eggs are removed from the *In* cooler and delivered in producers' cases to candling and grading stations in the packing lines. There are six such stations for each of the nine packing lines. At each station, a candler inspects the incoming eggs before a candling light and places them by visual quality grade into one of eight shuffle-feeding racks at the workplace. The shuffle feeders automatically transfer the eggs to a common, vertical elevator. At the time each egg is transferred, an electrical signal is sent to a memory unit that records the quality grade of that egg and its position on the elevator. From the elevator, eggs are passed through a weighing device at each station. The weighing device for a station classifies each egg into one of six weight categories, and drops it into a cup formed in a conveyor. The conveyor cups receive eggs from all six candling stations. Weight and position of each egg on the conveyor are also recorded by the memory unit, so that an egg of any quality grade and weight can be retrieved automatically. As an egg is placed in a cup on the conveyor, it is marked with invisible ink to enable later identification of the candler operator. A counting and printout cabinet at each handling station holds a record of size and grade totals handled. At the end of a producer's run, a ticket is inserted in the cabinet and the information is printed. The ticket is sent to the plant's data processing center where key-punched cards are prepared and production payment checks are automatically printed.

dling), and sort them by grade. Although this step of the process is still manual, relief of the operators from the necessity of weighing, coding, counting, and tallying have more than doubled the output of each candler. Accuracy of grading has also improved.

The egg packing lines and the entire handling layout, including automatic loading and storage equipment, were built by the Egg Handling Equip-



4 Preservative may be sprayed on selected eggs as they move through a coating zone on the way to the filling machine. Switches on the memory unit panel are preset to determine which eggs of the eight grade and six weight classifications possible are to receive the spray treatment. Only those eggs in the prechosen classifications will be sprayed as they pass through the coating zone. A blower removes excess solution before the sprayed eggs reach the filling machine.

ment Section, Food Machinery and Chemical Corp.

Following manual candling and grading, the eggs are automatically counted, weighed, coded with an ink visible only under ultraviolet light, and placed in cups on a conveyor leading to a carton and flat filling station. The invisible ink coding permits identifying the candlers for the purpose of checking their grading accuracy. A certain number of eggs are removed from the line on a statistical sampling basis and rechecked under ultraviolet lamps.

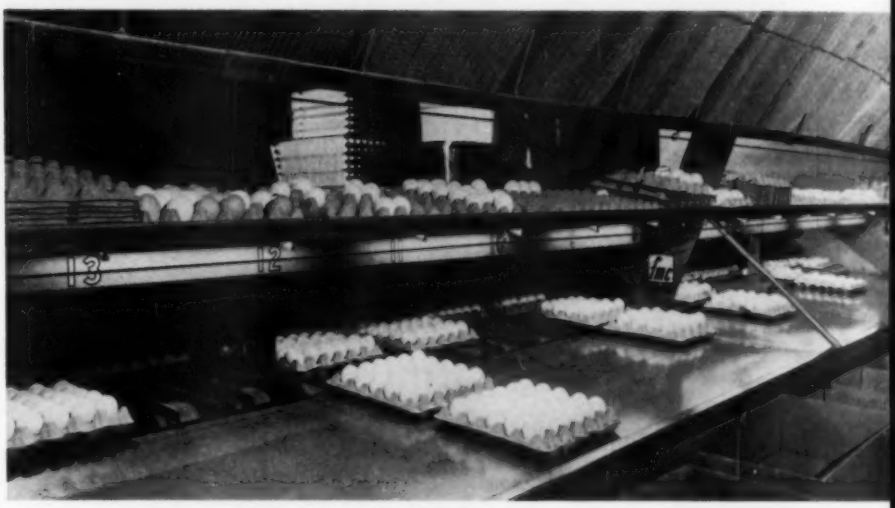
Controlled by an electrical "memory" system, the conveyor carries each weight and grade egg to an individual carton or flat and deposits it, small end down. Since some users, particularly the military, demand that a preservative solution be applied to the shell, the conveyor passes through a station which selectively sprays predetermined grades and sizes.

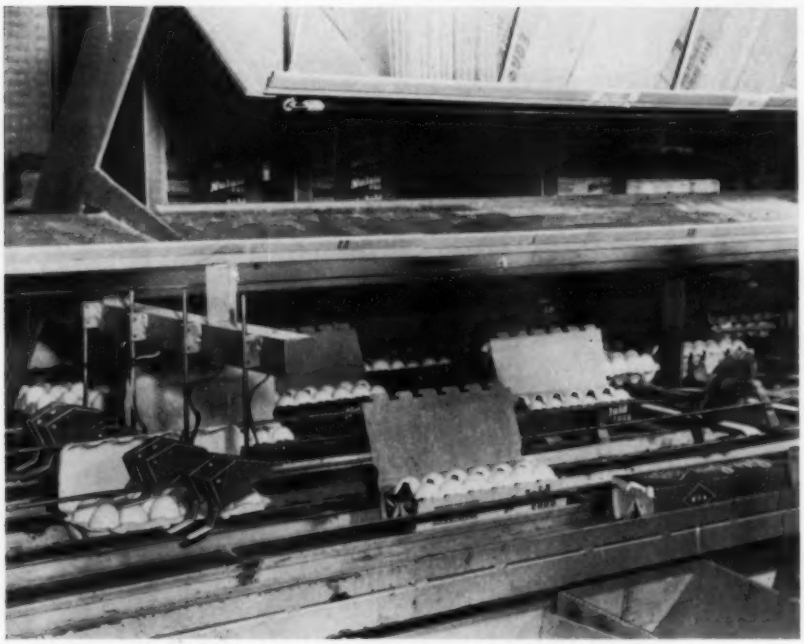
After filling, cartons move down the line, while flats are removed manually to be placed in cases. The filled cartons pass under a device which detects empty carton cells or extremely long eggs which might break when the cartons are closed. Either of these conditions will halt the line until the operator corrects the condition. The cartons are automatically closed and their covers date-stamped in a carton sealer.

From the sealer, the cartons proceed, according to grade and size, through chutes to a manual case-packing section. Full cases are placed on a con-

5

As the eggs travel on the conveyor into the filling machine, the selector section of the memory unit automatically releases each egg into a container according to its weight and grade classification. Flats, when filled, are ejected onto a table where an operator places them in cases. Unassembled cases are stored in racks above the machine stations.





6

Egg cartons with lids held open are positioned under the cup conveyor in the filling machine. Unit senses empty carton cells and fills a row, then the carton is indexed and the second row is filled. When twelve eggs have been placed in the carton, it is moved automatically onto a belt conveyor that takes it through a closing and marking machine. Cartons containing given sizes and grades are kept segregated. Detector switches at left sense empty carton cells and extra-long eggs that might break when the carton lids are closed. Switches will stop the carton and warn the operator when either condition is sensed.

veyor which takes them through case sealing machines to an *Out* cooler, where they are placed on pallets and stored on roller conveyors until they are required for loading.

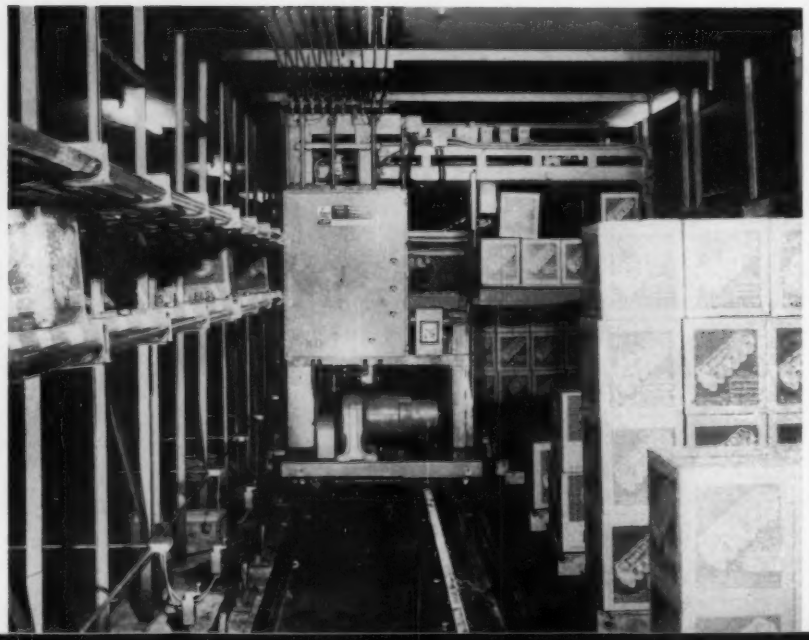
Loading is an automatic process. The cases of eggs are unloaded from the storage lines by a roving depalletizer, and transferred to loading conveyors. A large central control panel permits an operator to schedule an exact number of cases and half-cases of eggs for either of two trucks loading at the

7

Closed cartons pass under rotary coding heads that print the date eggs are packed. This dating procedure serves as a method of control of storage and shipment. Inflexible rule in packing plant is "first in, first out." After date coding, cartons are manually packed in cases and placed on conveyor leading to case sealer.

8

Sealed cases are delivered on multiple conveyors to the *Out* cooler where they are manually stacked on plywood pallets and moved forward on powered roller lines. Different lines are allocated to receive various grades and sizes of cased eggs. Pallets are supplied by overhead feeders from order-picking ends of roller lines.



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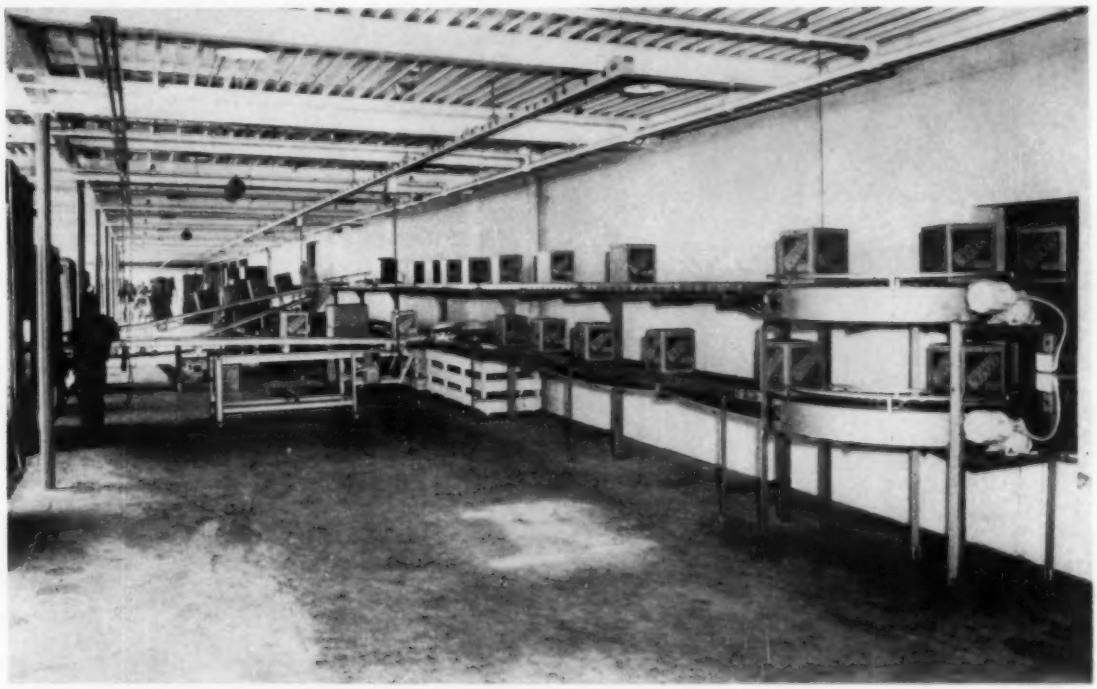
Roving depalletizer automatically searches for unfilled loading racks and supplies them by unloading and transferring cases of eggs from pallets at ends of *Out* cooler lines. After removing cases from pallet and placing them in rack, device places pallet on overhead feeder for return to input end of *Out* cooler lines. Double-deck loading racks are gravity roller type.

10

Programming is performed by this central control panel in the loading rack area. A selector switch is provided for each loading rack. The panel controls mechanical gates at the ends of the loading racks to release desired cases onto belt conveyors that lead outside to truck loading dock. Limit switches at each rack prevent release of cases when they may collide with others already on a conveyor. Panel also controls operation of depalletizer, and addition of small quantities of cases containing sizes or grades of eggs not often shipped. Latter are deposited on conveyors from supplementary loading racks.

same time. In addition, the control panel permits activating a special flow line to transfer small quantities of infrequently used varieties to the loading conveyors.

The storage rooms are kept at a constant temperature of 47 F and relative humidity of 80 per cent. The policy of "first in, first out" is rigidly observed both for incoming and outgoing orders. The packing room is air conditioned to maintain minimum temperatures consistent with worker comfort. Over 300 tons of refrigeration are utilized throughout the plant.



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Conveyors move cases of eggs of preselected sizes and grades, in quantities required to make up an order, to truck loading area. Two trucks can be loaded simultaneously at the refrigerated loading dock. Conveyors to each truck are movable to provide flexibility in serving a line of waiting vehicles.

Fig. 1—Extensive capabilities of control system are shown in general block diagram. System monitors wide range of variables to obtain data with which to compute control action necessary to optimize process. Outputs of the control system can be in form of data presented as a guide to operating personnel or as signals to directly actuate control elements.

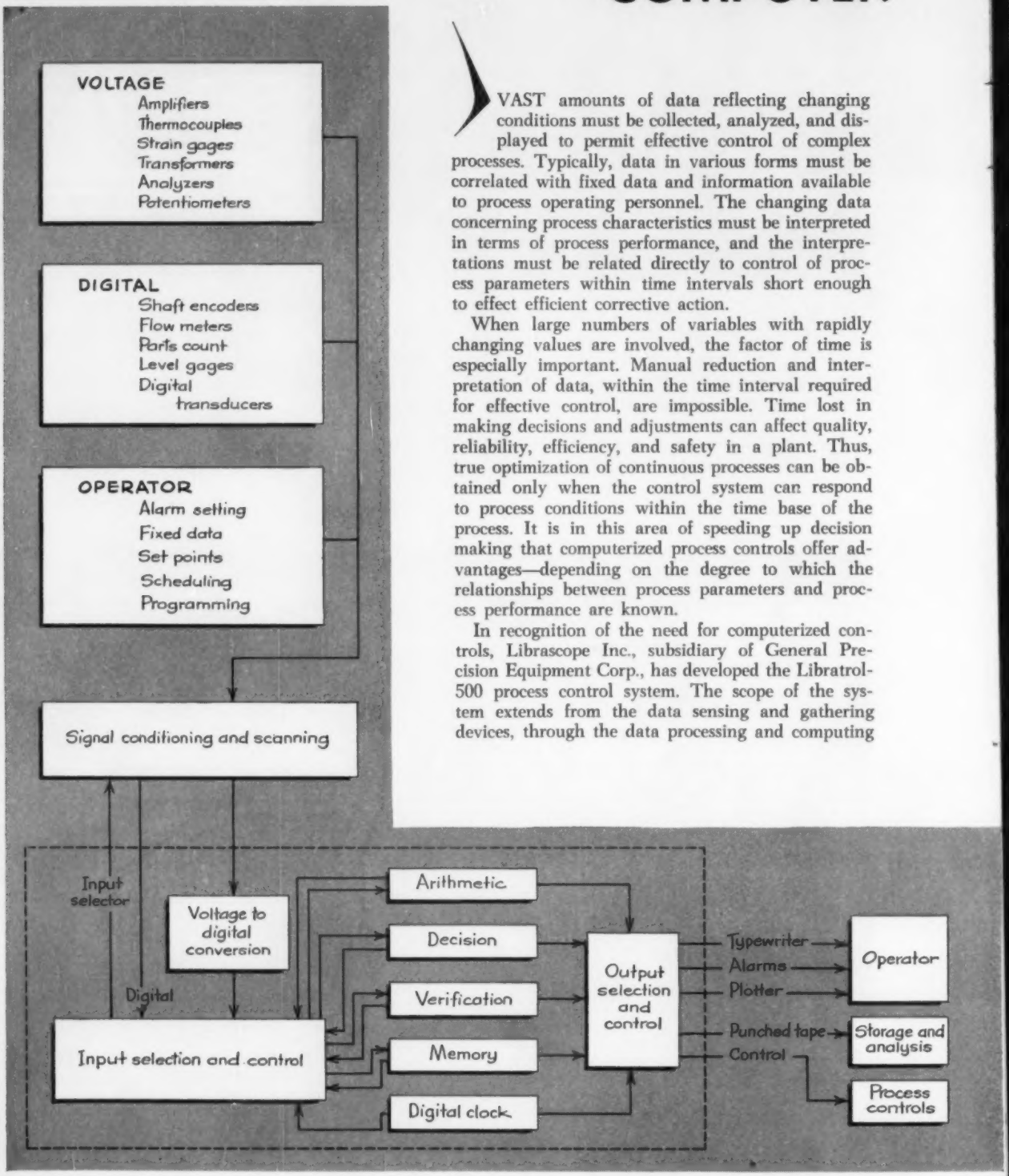
FROM PILOT STUDY

COMPUTER

VAST amounts of data reflecting changing conditions must be collected, analyzed, and displayed to permit effective control of complex processes. Typically, data in various forms must be correlated with fixed data and information available to process operating personnel. The changing data concerning process characteristics must be interpreted in terms of process performance, and the interpretations must be related directly to control of process parameters within time intervals short enough to effect efficient corrective action.

When large numbers of variables with rapidly changing values are involved, the factor of time is especially important. Manual reduction and interpretation of data, within the time interval required for effective control, are impossible. Time lost in making decisions and adjustments can affect quality, reliability, efficiency, and safety in a plant. Thus, true optimization of continuous processes can be obtained only when the control system can respond to process conditions within the time base of the process. It is in this area of speeding up decision making that computerized process controls offer advantages—depending on the degree to which the relationships between process parameters and process performance are known.

In recognition of the need for computerized controls, Librascope Inc., subsidiary of General Precision Equipment Corp., has developed the Libratrol-500 process control system. The scope of the system extends from the data sensing and gathering devices, through the data processing and computing



TO PRODUCTION PROCESS

CONTROL ADAPTS TO NEEDS

modes, to the final decision making and controls actuation.

The basic building block of the process control system is a reliable electronic digital computer specifically designed for the computation and control requirements peculiar to process control. The computer, operating on input information supplied by the process instrumentation (voltages from analog instruments, pulses from digitizing transducers), performs computations, logic manipulation, and decision making operations required to effect the control actions. Computer operation is serial, single address, fixed binary point, with internally stored program.

Inputs to the system are scanned and conditioned on command from the internal stored program regulating the computer functions. The program directing the computation and control system operations can be modified to incorporate desired operating functions.

Outputs from the computer may be in the form of voltages to actuate control elements, digital data for presentation to operating personnel, or punched tape for further data processing operations.

In the basic mode of operation—data processing—the system monitors a process, compiles various data, performs required computations, and presents the information through a typewriter to the process operator. Specific information vital to accounting can be punched on tape. With this mode of operation, evaluations and decisions are the responsibility of an operator.

Computer-directed control is another mode of operation. Here, the system calculates, on the basis of monitored data and logic program stored in the computer, what the optimum set points should be to realize maximum efficiency, maximum output, or to reach a desired operating state in the minimum time. This information is presented to the operator who is free to consider additional factors which the program might not cover before altering the process controls.

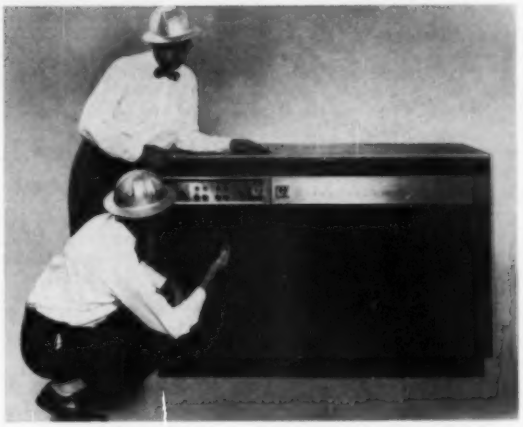


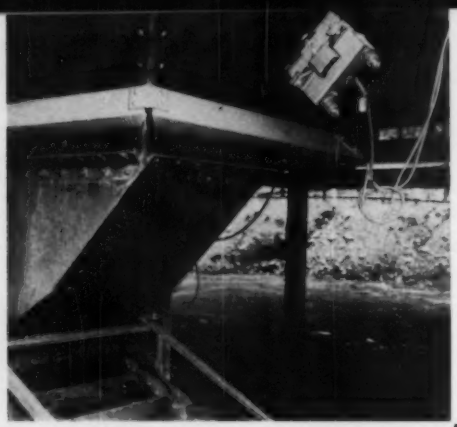
Fig. 2—Computer is basic building block in Libratrol-500 process control system. Speed with which computer operates to manipulate large quantities of data is primary justification for computerized controls.

In those processes where the relationships between the variables and performance are well enough established, the system can be used in a third mode of control: automatic control of processes. The computer is placed in and closes the control loop. Instantaneous regulation of the process is accomplished by conventional feedback controllers with the computer carrying out automatic trimming operations by monitoring set points and changing them as calculations indicate the necessity.

The ability of the control system to grow with development and expansion of the process is insurance against obsolescence. Whatever the level of analytical knowledge of the process performance, valuable contributions to optimizing the process can be made by application of the system to the problem of determining the effects of variations in critical parameters. In short, the range of usefulness of the system extends from the pilot-plant study through the various stages of development leading to automatic process control.

INDUSTRY	APPLICATION
Petroleum and petrochemical	Plant stream optimization Pipe line monitoring and control Tank farm gaging and processing
Gas utilities	Monitoring & control, totalizing
Electrical utilities	Monitoring & control, totalizing
Metals	Mill operation and control Furnace control & data processing
Atomic energy	Reactor control & data processing
Aircraft & missiles	Initial data evaluation On line monitoring

Fig. 19—Some of the uses of vibratory devices for agitation are shown by these illustrations. Applications to promote flow of bulk materials are well known, but more unusual are related applications in the chuting of fragile discrete items such as ice cream cones and the alignment of parts for assembly.

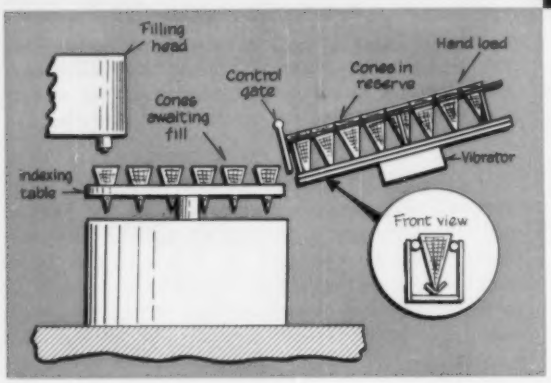


Courtesy, Syntron Co.

Vibrator here is used to assure continuous flow of coal from a tipple bin to a cleaning plant. This type of application is one of the most widespread uses of vibratory equipment.

Agitation of a liquid bath or slurry can also be obtained by mounting a vibrator on a paddle or agitator element.

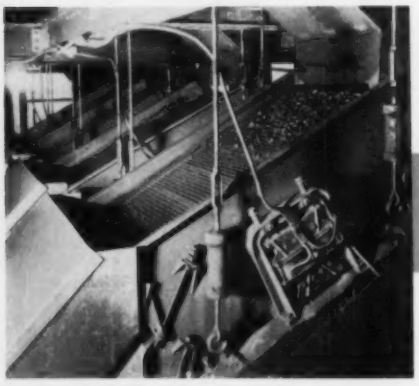
Courtesy, Cleveland Vibrator Co.



Flow of fragile sugar cones to an automatic ice cream specialty machine is assisted by use of a vibratory unit.

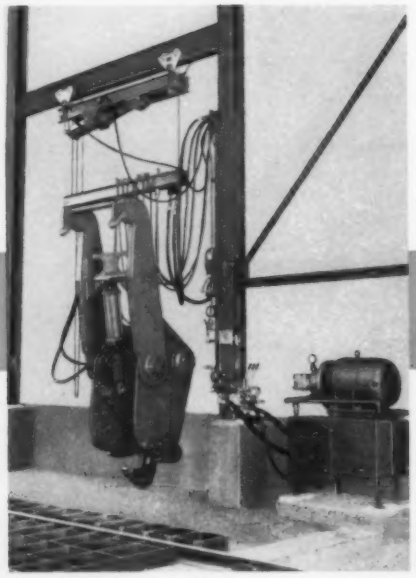
Lapping operation is performed in this vibratory unit. As parts are moved around by the vibration of the bowl, they are finished by the special bowl surface.

Courtesy, Syntron Co.



Courtesy, Jeffrey Mfg. Co.

Agitating effect of a vibrator is used in this vibrating screen unit to promote flow of coal over and through screen openings.



This large vibratory unit can be clamped on a railroad car and used to speed unloading of the car.

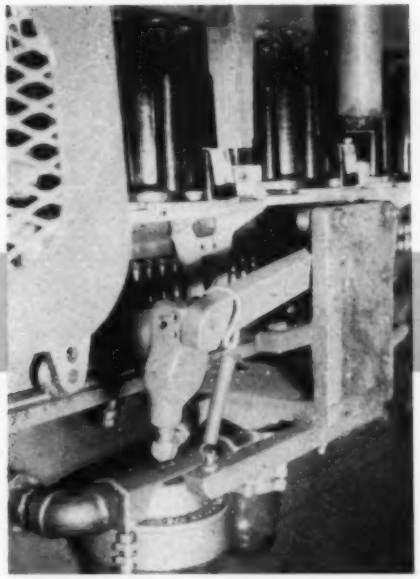
Courtesy, Stephens-Adamson Mfg. Co.

VIBRATORY AGITATING AND PROCESSING

Besides their applications in feeding and conveying, vibratory units are widely used as agitating devices and in installations where feeding, conveying, agitating, and other functions are combined. Vibratory equipment for such uses may perform desired operations more efficiently than any other means.

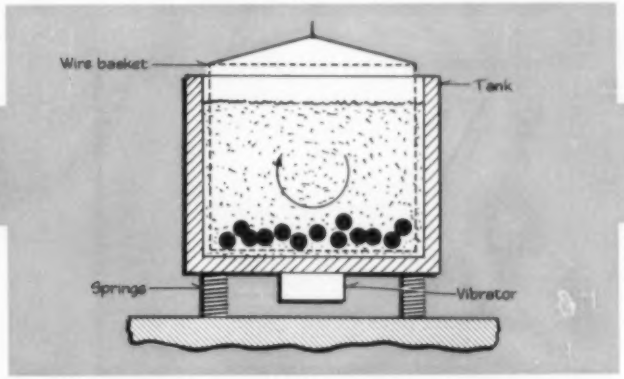
By **LESTER R. MOSKOWITZ**, Director, L. R. Moskowitz & Associates, Erie, Pa.

BEST KNOWN applications of vibratory equipment are probably those which use vibrators only to produce agitation. Equipment used for this purpose is usually the simplest form of vibrator. Essentially, such units are the basic operating types described earlier in this series of articles. (See Part 1—AUTOMATION, Dec., 1958.) However, the piston, rotating ball, rotating cam, or armature must be relatively massive to produce the magnitude of oscillatory forces required. In some units the mass actually impacts with hammer-like blows against the housing during portions of the operating cycle.

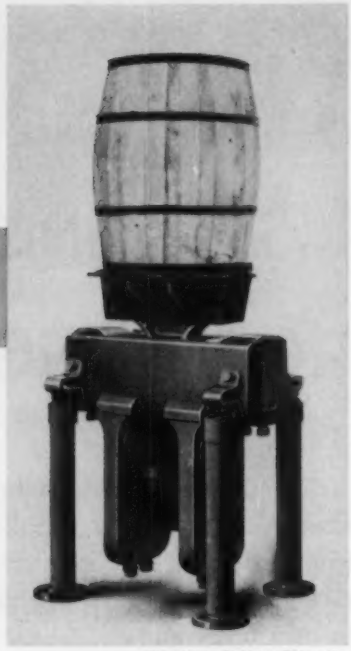


Courtesy, Martin Engineering Co.

Pneumatic rolling-ball type vibrator, shown in this closeup, helps to align a pair of pins during the automatic assembly of an automotive distributor cap.



To accelerate cleaning of parts and produce a circulatory flow in a liquid-filled tank, a vibrator can be used as shown. The tank must be resiliently mounted.

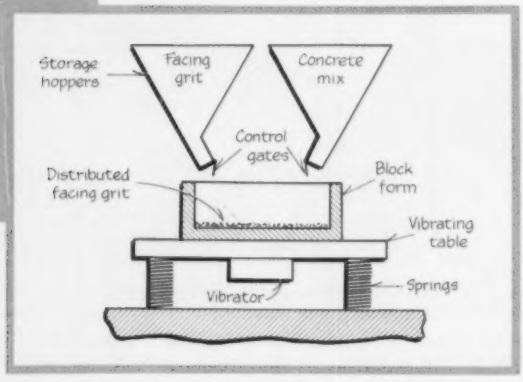


Courtesy, Jeffrey Mfg. Co.

Compacting of contents of a barrel on this vibratory unit allows more effective filling of the barrel.

Courtesy, Martin Engineering Co.

Vibration is used to dislodge filter cake from the filter elements in the liquid filter shown. Operation is normally performed with the vessel closed.



Tendency of vibration to evenly distribute material is used in this example to spread a granular facing material uniformly in a form before concrete is added.

The direct mechanical linkage type is seldom used for agitative purposes either with or without impact.

Vibratory devices are used for agitation in a variety of ways. Most common among these are the following:

1. Assist in the discharge of materials from bins or hoppers.
2. Promote mixing of dissimilar materials.
3. Assist in locating and orienting objects.
4. Accelerate cleaning, washing, or ion exchange processes.
5. Promote flow of materials in chutes and slides.
6. Promote the compacting of materials.
7. Assist in screening or grading of objects or materials.

The means by which vibrators assist in the discharge of materials from bins or hoppers and promote the flow of materials in chutes and slides is to reduce the effects of friction. The action of the vibrators reduces the effect of friction between the material and the walls of the bin or chute and between the individual particles of the material or between individual parts. The reduction in friction with the bin walls is accomplished by alternately driving in and releasing the bin wall. The friction between particles is reduced by agitation of individual particles with respect to each other.

Typical applications of vibratory devices of the pneumatic-hydraulic, electromechanical, and electromagnetic types to produce agitation are shown in *Fig.* 19. There are relatively few other means for accomplishing the functions illustrated. Most common of the other means are the air diaphragm devices; the aerating devices; paddle, tumbler, and fluid jet agitators.

Primary advantage of vibratory types is their versatility, TABLE 6. They can be applied in a variety of ways to perform virtually any of the agitative functions, whereas, other means are applicable only to limited varieties of problems. A vibratory unit can be used to vibrate bin walls, chutes, and fluid baths.

Advantages of vibratory equipment with regard to reliability, low maintenance, and applicability to corrosive or high temperature areas arise primarily from the fact that the equipment generally operates indirectly upon the material or objects to be agitated. That is, the vibration is transmitted through the walls of containers or by means of tables, and the vibratory device itself is not in contact with the material or objects.

The most serious disadvantage of vibratory agitative devices is the difficulty encountered in applying the units to specific installations. Relatively few scientifically sound guides to their proper application are available. In many cases, the size of unit, its location on the equipment to be vibrated, and other

TABLE 6

Features of Vibratory Units Used For Agitative Purposes

Advantages

1. Versatility.
2. Low initial cost.
3. Reliability.
4. Low maintenance.
5. Applicable in corrosive and high temperature areas.

Disadvantages

1. Difficult to apply properly.
2. Possible damage to other equipment.
3. High noise levels.

factors are decided largely upon the experience and judgment of the individual making the selection. No two applications are exactly alike. For example, two apparently identical bins may behave entirely differently depending upon such factors as the quality of welds, the material placed in the bin, the supports provided on the bin, and the effects of nearby equipment.

Effects of vibratory equipment on the object to be vibrated and on associated equipment can pose serious problems. Improperly designed bins or chutes may literally fall apart under prolonged vibration. Rigid hydraulic or air lines, weighing devices, and electronic equipment may be damaged or malfunction as a result of vibration transmission.

Noise produced by vibrators used for agitation is frequently a problem. Even when so-called noiseless units are used, the noise levels may be objectionable since the object being vibrated may be the source of the noise rather than the vibrator itself. However, noise levels can usually be minimized by proper selection and location of the vibrator and by proper isolation of the object being vibrated.

▶ Combined Functions

Besides the basic functions of transporting material or agitating material, vibratory equipment is also adaptable for applications combining feeding, conveying, agitating, and/or other processing functions. These combined-function applications include timing, mixing, spreading, sorting and separation, drying, heating, cooling, aerating, polishing, and many other operations. Several examples of combinations of functions are illustrated in *Fig.* 20.

Many of these installations combining functions make use of the ability of vibratory feeders to move materials freely in a direction differing from the direction of flow of a processing medium. Others

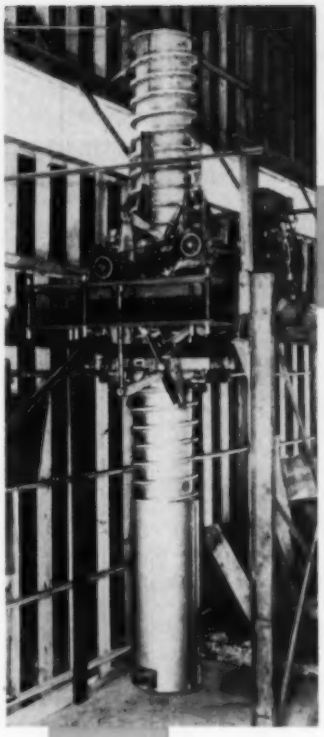
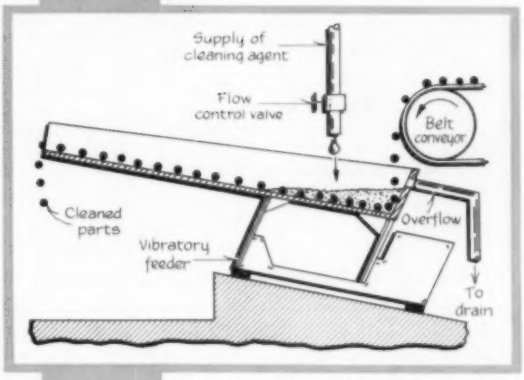


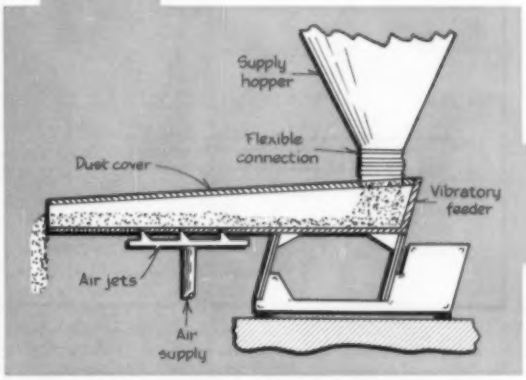
Fig. 20 — Combinations of feeding, agitating, and other functions are illustrated by these examples.

Convenient control of quenching time is provided by use of this overhead-drive helical feeder. Base of flight is immersed in quenching fluid. Heated parts are chuted to the base and carried up at a constant speed by the feeder. Quenching time is adjusted by controlling the level of fluid in the tank.

Courtesy, Carrier Conveyor Corp.



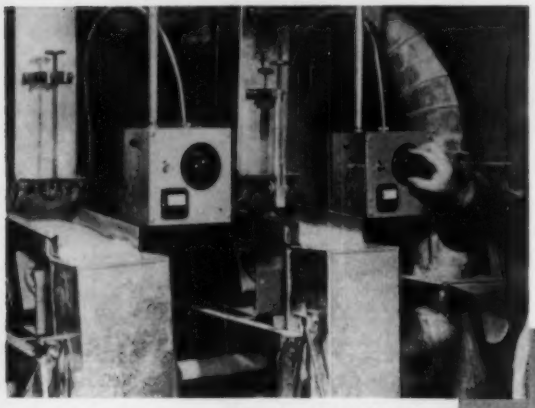
Vibratory feeder with special tray can be used for continuous cleaning or degreasing of parts. Cleaning agent is shown flowing counter to parts motion.



Air jets in tray assist in drying, cooling, or aerating bulk material during feeding.

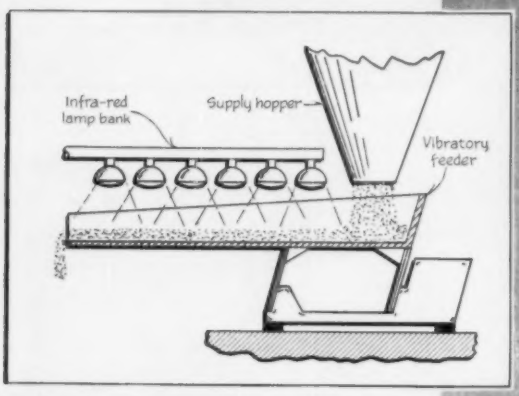
take advantage of the inherent spreading characteristic of vibratory units to obtain uniform depths of material being heated, cooled, or subjected to other treatments. Still others rely on the agitating effects to promote mixing as materials are transported at controlled rates from points of supply to points of discharge.

The range of possibilities for the effective use of vibratory feeders, conveyors, agitators, and other devices is very wide. These articles have outlined some of those possibilities so that potential uses may be more easily recognized by readers facing similar problems.

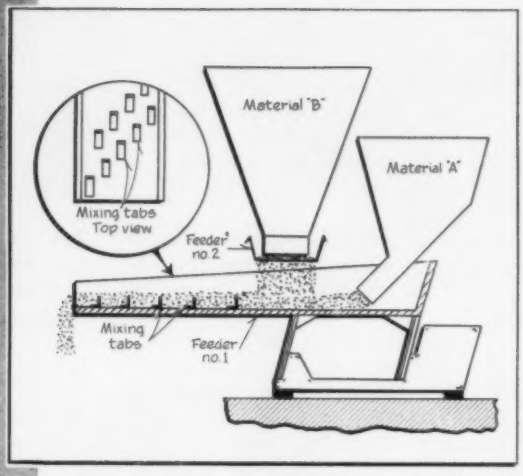


Courtesy, Eriez Mfg. Co.

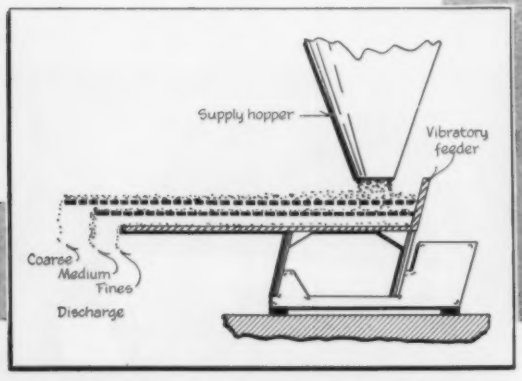
Combination of two or more feeders allows proportioning of ingredients fed to a mixing device. Flows of limestone and bicalcium phosphate are being controlled in the production of poultry and dairy feeds.



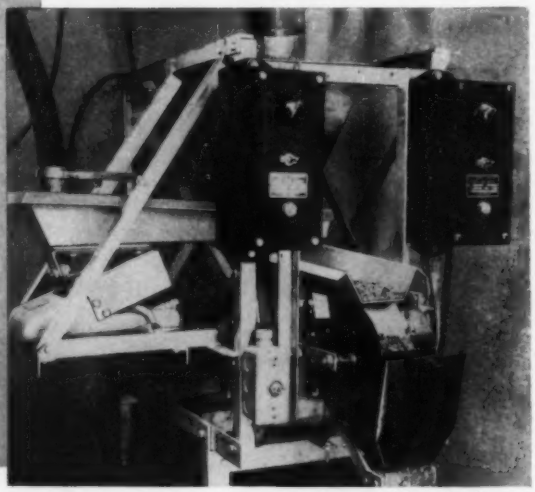
Overhead heating lamps can be used with a vibratory feeder to provide a uniform drying or warming function.



Mixing as well as proportioning of two materials can be accomplished with two vibratory feeders in the manner shown.



Vibratory feeder equipped with two screens can grade bulk material into three size classifications during feeding.



Courtesy, Syntron Co.

This application of two feeders, for proportioning and mixing, spreads a thin layer of salt over a potato chip specialty and delivers a controlled flow to a weighing hopper.

Fig. 1—The old and the new; flashlight lamps were formerly packaged in paperboard platform insert cartons *(a)* that lacked sales appeal and could not be displayed conveniently. Shipping, retailer, and consumer benefits resulted from redesign of package as a self-display unit *(b)*. Each lamp in new package is enclosed in protective plastic blister.

AUTOMATIC BLISTER PACKAGER

ENHANCES PRODUCT SALES POTENTIAL

By **C. J. SCHEER**, Manager, Manufacturing Engineering, Miniature Lamp Dept., General Electric Co., Cleveland, Ohio

LAMPMAKING is an excellent example of early utilization of the techniques of automation. But for the use of automatic equipment and processes in the manufacture of lamps, today's demands could scarcely be met economically. It has been estimated that, if 1910 production methods were to be employed to supply present demands, the price of a 100-watt bulb would be $4.10 instead of the prevailing low figure of $0.25.

Technology in manufacture of miniature lamps for use in flashlights and other low-voltage devices has kept pace through innovations of its own and adoption of some of the advances made in the manufacturing techniques applied to larger lamps. However, in one area—packaging—progress was relatively slow in coming.

For many years flashlight lamps were hand packaged in paperboard platform insert boxes, *Fig.* 1*a*.

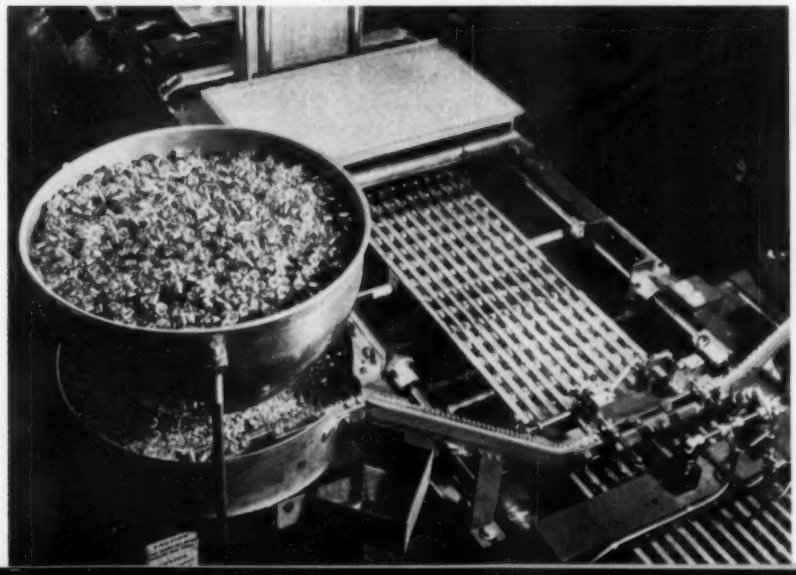


Fig. 2—Vibratory feeders on either side of machine deliver flashlight lamps to loader mechanism. Loader inserts ten lamps at a time in vacuum formed cavities in continuous plastic web.

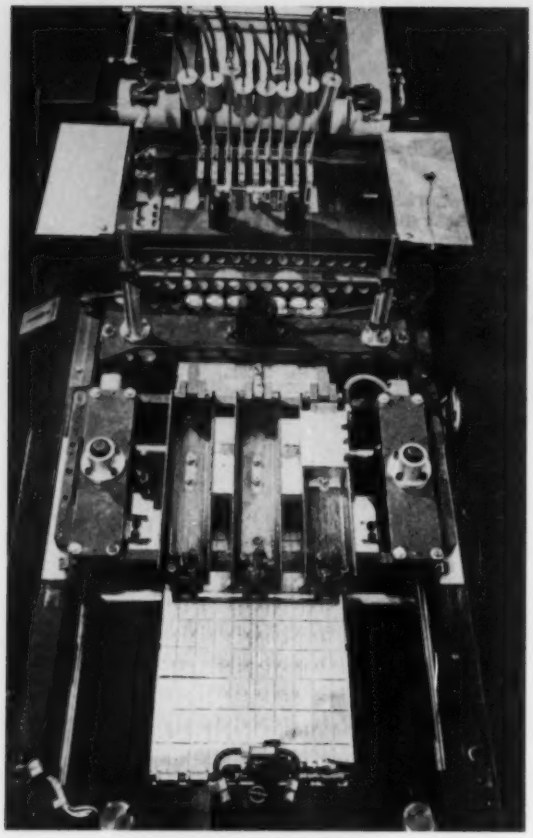


Fig. 3—Preprinted cardboard backing strips are heat sealed to web in Step 3. After sealing, strips and web are perforated between blisters to facilitate customer removal of desired number of lamps from strip.

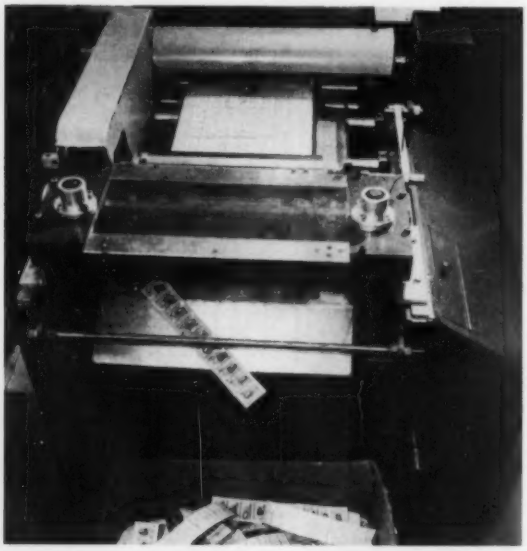


Fig. 4—Final trimming operation is performed in Step 4. Individual strips containing ten lamps are discharged from machine, ready for preparation for shipping.

Packaging was necessarily a slow process, and from the retailer's point of view the boxes were hard to stack and lacked sales appeal.

After analyzing the marketing situation, General Electric Co. decided that: 1. A new type of package was necessary to increase sales of flashlight lamps and to keep up with the trend toward use of self-displaying items. 2. The new package needed to have sales appeal. These merchandising advantages had to be provided at no appreciable increase in cost.

Meeting these objectives with a new package, *Fig. 1b*, was made possible by the acquisition of an automatic blister packaging machine designed and built by Packaging Industries Inc. The machine packages flashlight lamps automatically, at a rate of approximately 18,000 units per hour, in four steps. In Step 1, a web of cellulose acetate material taken from a roll is preheated by quartz lamps and portions of the web are drawn downward by vacuum to form cavities. Ten cavities are formed across the web in each forming cycle, corresponding to the number of flashlight lamps to be loaded in each cycle of a subsequent loading stage.

In Step 2, *Fig.* 2, flashlight lamps are delivered to a loading device by vibratory feeders on either side of the machine. The loading device deposits lamps ten-at-a-time in cavities in the plastic web. Each vibratory feeder is charged with supplying the five cavities on its side of the machine.

Preprinted cardboard backing strips are fed by gravity from a magazine in Step 3, *Fig.* 3. Each strip covers ten cavities across the web. After heat sealing of the cellulose acetate to the backing strips, the strips and adhering plastic are perforated between each blister. This facilitates customer removal of less than a full quantity of lamps in a package. The customer simply tears off the desired number of lamps from a strip in the display package.

A trimming operation in Step 4, *Fig.* 4, separates the individual strips of ten lamps and sizes them for insertion in self-display cartons. To prepare them for shipping, the strips are broken into units containing five lamps. Two such units are nested with their cardboard backings facing outward and are taped together.

The new package, made possible through adoption of modern packaging techniques performed on automatic equipment, brings several benefits to the retailer: 1. Multiple-unit and impulse sales are increased. 2. Shelf life of the lamps is lengthened. 3. Pilferage and breakage losses are reduced. 4. Each lamp can be price-marked on its cardboard backing.

For the consumer, the new package has these advantages: 1. Each lamp is completely visible, making base as well as bulb type identification possible at a glance. 2. Each unit is marked plainly as to size and number of batteries it is designed for. 3. The customer has a well-protected packaged unit if he buys a spare lamp.

Ordinarily, the predominant reason for adopting automation is to obtain manufacturing economy. In this instance, automatic productive facilities were specified mainly to provide retailers and consumers with a more attractive, better-packaged product.

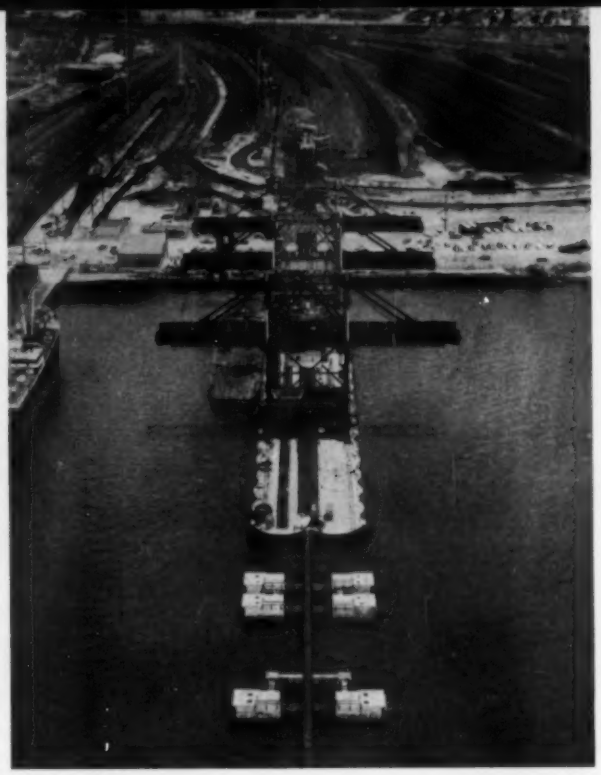


Fig. 1—Ore unloading facility of Chesapeake & Ohio Railway Co. at Newport News, Va. Variety of ores are removed from ships and transferred to railway carriers. Setup includes automatic weighing system that prints out net contents of each carrier on a waybill.

ELECTRONIC WEIGHING SYSTEM

IMPROVES ORE HANDLING OPERATION

By **JAMES W. KREBS,** Gilmore Industries Inc., Cleveland, Ohio

MANY bulk material handling operations require the keeping of accurate business records showing the quantities and types of materials handled, and their disposition. Such is the case at the Newport News, Va., ore unloading facility of the Chesapeake & Ohio Railway Co., *Fig.* 1. Bulk cargoes of chrome, manganese, iron, bauxite, and other ores are unloaded from ships at this installation, and loaded into railway carriers for transshipment to various destinations. The contents of each railway carrier must be known for accounting and billing purposes.

To provide accurate information on the weight of ore loaded into each railway carrier, an electronic weighing system designed and built by Gilmore Industries Inc. was included in the new facility. An automatic waybill printout feature of the weighing system provides permanent records of the net weights delivered.

▶ Handling Procedure

Steps in the unloading of ore from the hold of a docked ship and depositing it in measured quantities in railway carriers are illustrated in the simplified flow diagram of *Fig.* 2. Ore is removed by unloaders, *Fig.* 3, that include buckets capable of taking 18-ton "bites" every 45 seconds. The unloaders, built by Demag A.G., Duisburg, Germany, are of a slewing-

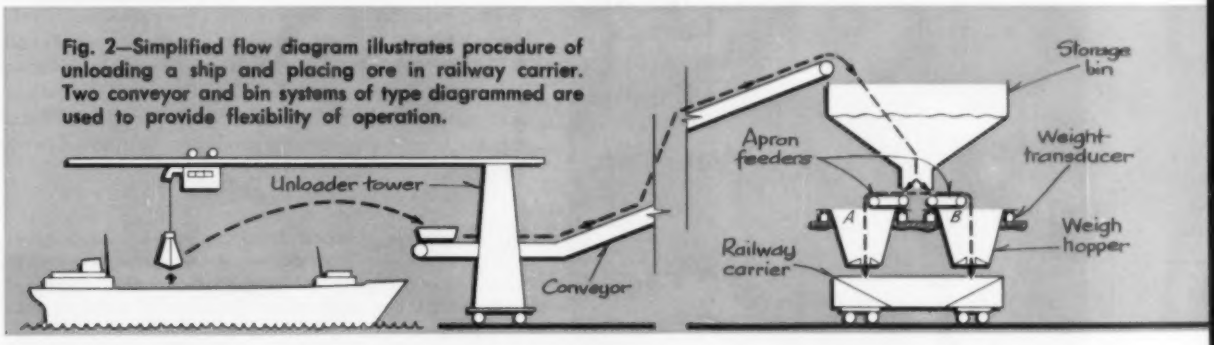


Fig. 2—Simplified flow diagram illustrates procedure of unloading a ship and placing ore in railway carrier. Two conveyor and bin systems of type diagrammed are used to provide flexibility of operation.

Fig. 3—One of three unloaders used to remove ore from ships. Two vessels, or three holds of a single ship, can be worked simultaneously. Interchangeable buckets are available in different sizes; largest has a capacity of 18 tons of ore.

jib type in which the operator's cab can rotate 360 degrees as well as travel back and forth on a projecting support structure. Flexibility provided by this action makes it possible to place the bucket at virtually any point in a ship's hold without moving the unloader tower along the pier. Three movable unloaders can work two vessels simultaneously or three holds of a single large ship.

Ore picked up by the buckets is dropped into hoppers in each of the unloader towers and is transferred to one of two parallel conveyor belts. The conveyor belts, *Fig.* 4, elevate the ore and drop it into separate storage bins in a carloading house inshore. The flow from either conveyor belt can be directed to either storage bin, providing flexibility of operation and permitting segregation of grades and types of ore. Capacity of each storage bin is 600 to 900 tons, depending on the type of ore handled.

Apron feeders at the bottom of each storage bin are actuated to feed ore to two weigh hoppers. When a load is made up in the weigh hoppers it is dropped into railway carriers rolled underneath, *Fig.* 5. Since there are two storage bin and weigh hopper systems, two carriers can be loaded simultaneously. Type of ore may be different for each carrier. The setup, exclusive of unloaders and electronic weight controls, was provided by McDowell Co. Inc.

▸ Automatic Weighing

An electronic weighing system was chosen for each car loading station for several reasons:

1. Use of sealed electrical weight transducers at the weigh hoppers would provide greater protection against abrasion, contamination, and corrosion than would mechanical systems using pivots and knife edges.

2. Instrumentation and controls could be remotely located at a central control point.

3. Temperature compensation could be provided to maintain weighing accuracy over a wide range of ambient temperatures.

4. Interlocks, delays, and other electrical provisions could be readily incorporated in the control circuit to assure correct sequencing of the weighing system.

5. Accuracy would be such that small amounts of material retained in the weigh hoppers could be sensed and corrections made.

6. Existing totalizing, computing, and printout devices could be used directly in an electronic system. A digitizing method would make possible later use of punch cards or tape to integrate the weighing system into an over-all business system.

In operation of the automatic weighing system, an operator at a central control point, *Fig.* 6, adjusts the set points of two electric scales, one for each weigh hopper above a carrier to be loaded. For a 70-ton capacity car, for example, he may choose values of 68,000 pounds for each weigh hopper *A* and *B*, *Fig.* 2. He then inserts a card in a calculating printer, and depresses *Start Feed* buttons that start the apron feeders for each weigh hopper. When signals from the weight transducers associated with

Fig. 4—Ore is dumped from unloaders into hoppers above conveyors that deliver it to carloading house where it is dropped into storage bins. Dual conveyor and storage bin setup allows handling of different ores and filling of two railway carriers simultaneously.

Fig. 5—Ore is dumped by weigh hoppers into both ends of a railway carrier. Signal for dumping action is transmitted from central control point.

Fig. 6—Control room contains instruments and controls for checking, regulating, and recording operation of automatic weighing system that places predetermined quantities of ore in railway carriers.

weigh hoppers *A* and *B* indicate that the desired weights of ore have been added from the storage bin, the apron feeders stop.

Due to overshoot or lump feed, however, the hoppers may not have the exact amounts called for on the scales. Actual input readings, for example, may be 68,200 pounds for hopper *A* and 68,400 pounds for hopper *B*. By pressing a *Gross Weight* control, the operator records on the card the individual weights of material added to the hoppers and the total, in this case 136,600 pounds.

The material in the weigh hoppers is released into the railway carrier when a *Dump* control is actuated. Signal lights at the control point indicate if excessive material is retained in either hopper after dumping.

The actual weight of ore that is dropped into a given car, however, may differ from the amounts loaded into the weigh hoppers for two reasons: 1. Material may have been retained in a hopper. 2. Previously retained material may break loose and be carried along with the material added.

To obtain the actual weight of ore dropped into a car, the operator pushes a *Light Weight* print button. This causes the printer to record the light weights of weigh hoppers *A* and *B* and the net weight delivered to the car. For example, a light weight of 2400 pounds for hopper *A* indicates that amount of material retained in the hopper. A light weight of −300 for hopper *B* would indicate that hopper released 300 pounds of material in excess of the amount added to it in the operation being measured. The printer automatically computes 136,600 − 2400 + 300 and prints 134,500 as the net weight of ore in the car.

A block diagram, *Fig.* 7, illustrates the elements used in the automatic weighing system for one weigh hopper. Electrical signals from weight transducers associated with the hopper are fed to a measuring circuit where they are compared with signals from a balance slide wire. The resultant error signal is amplified and used to determine the angular position of the shaft of a servomotor. A rotation encoder mechanically connected to the shaft of the servomotor converts shaft rotation to a form suitable for input to a translator. Output of the translator is fed to a calculator. When *Gross Weight* and *Light Weight* pushbuttons are operated, a pulse forming network is actuated that causes the calculator to print out weight information on the waybill. Printing is in 100 pound increments.

Size and type of operation, and business requirements, usually establish the degree of automatic control that can profitably be applied in a given bulk material handling installation. In cases where accurate weight control and recording are required, electronic control means are often the economical choice, and may be the only feasible way of providing the requisite system performance.

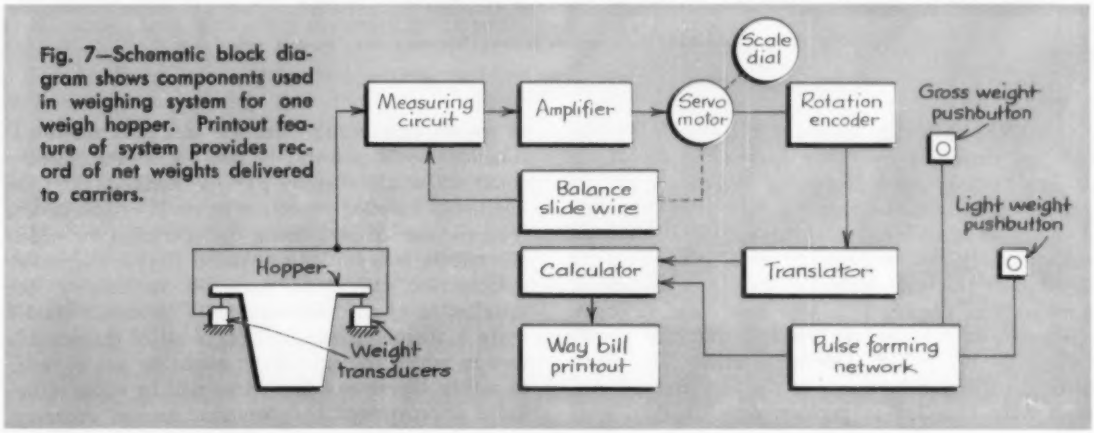


Fig. 7—Schematic block diagram shows components used in weighing system for one weigh hopper. Printout feature of system provides record of net weights delivered to carriers.

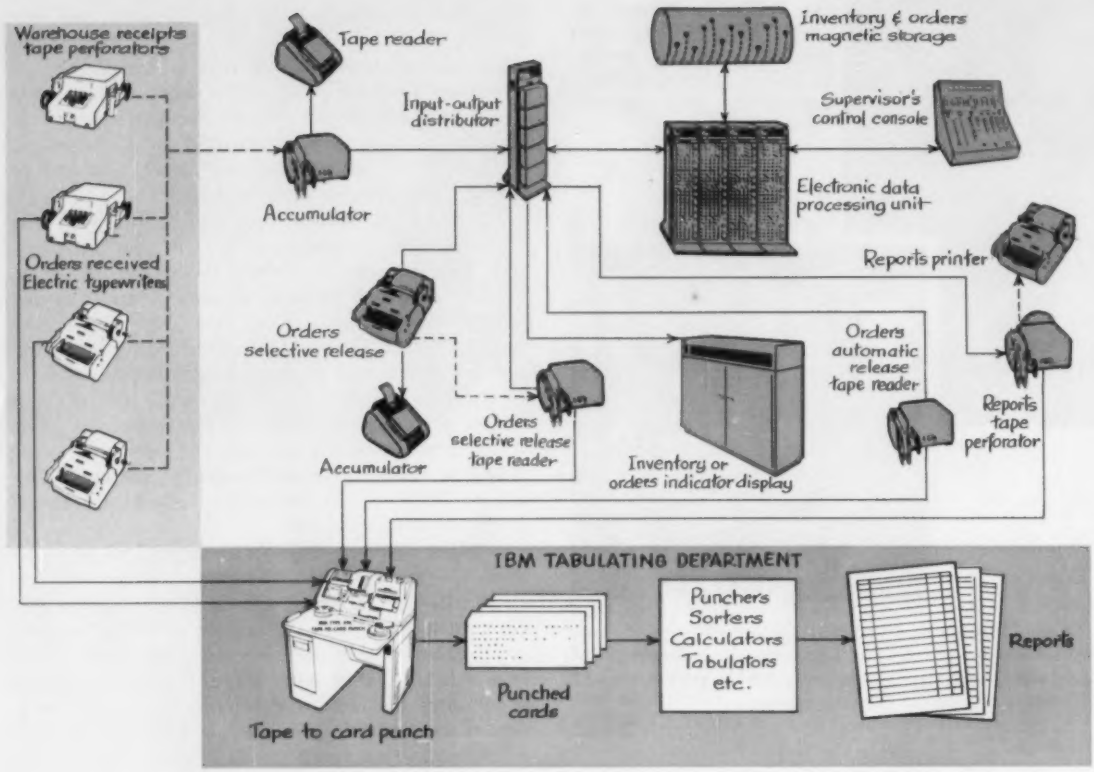


Fig. 1—Diagram of inventory control system installed at Watertown, Mass. plant of the B. F. Goodrich Footwear and Flooring Company, division of B. F. Goodrich Co. System produces, on demand, a tabular description of quantities of footwear on hand, as well as committed orders. The magnetic storage drum contains information on many thousands of style-size-color variables for a wide range of footwear brands and models.

HOW TO BEGIN?....WHAT SHOULD BE EXPECTED?....

PREPLANNING FOR ELECTRONIC INVENTORY CONTROL

By **ALFRED JAMES,** Senior Methods Engineer, Teleregister Corp., Stamford, Conn.

ANALYSIS of systems and procedures in order to determine whether or not to install an electronic data processing system is an expensive and time-consuming operation for any corporation to undertake. However, failure to make such a study can be far more costly if the wrong decision is reached. It has been the experience of a number of corporations who now have extensive electronic data processing systems that the installations do not fulfill their expectations. In many instances this can be traced to the fact that the systems were installed to perform one function, such as payroll accounting, with the idea that additional functions could probably be added later and that the computer would thereby pay for itself. Where the additional functions were not or could not be added, then the cost of performing the operation for which the system was initially installed is not warranted.

Corporate executives who are considering the installation of an electronic data processor should make a thorough investigation of all of the possible uses to which the equipment might be put in order to satisfy themselves that there will be either a definite improvement in operation, greater accuracy,

As a beginning point in undertaking a program of system improvement, it is helpful to orient one's thinking relative to general aspects of the problem. Here the author considers preliminary questions that a prospective user of electronic data processing equipment should ask himself before commencing a formalized study of the details of the problem.

greater speed, a decrease in expense, or a combination of these advantages. Manufacturers of electronic data processing equipment will co-operate with customers in making a cost justification study. However, the potential customer can be better prepared for the study if he gives preliminary consideration to the basic questions proposed later in this article.

In order to determine how these questions may be applied let us first consider the case histories of the installations made by the Teleregister Corp. for the B. F. Goodrich Footwear and Flooring Co., Div. of B. F. Goodrich Co. in Watertown, Mass., and the systems being built for the Howard Savings Institution of Newark, N. J.; the Society for Savings of Hartford, Conn.; and the Union Dime Savings Bank of New York City.

The B. F. Goodrich footwear operation was faced with a sizeable inventory control problem. The firm manufactures 30,000 different styles, sizes, and colors of footwear; plant production goes into the warehouse inventory at the rate of some 6,000 entries per day. They were experiencing a great deal of difficulty in achieving and maintaining a balance between customer orders, production, and inventory. It took about 5 days from the time footwear went from the Watertown plant into warehouses before information was available to permit distribution of the merchandise to branches and dealers. Their basic problem was to reduce the warehouse inventory necessary to fill orders. They desired to balance inventory against committed orders, instead of manufacturing and carrying in stock every variation in style, size, and color of a particular line of footwear. This would reduce the variables in manufacturing to the styles, sizes, and colors necessary for immediate commitments, *Fig.* 1.

The banks were also concerned with a problem of inventory control, but their inventory consisted of dollars. The banks required instantaneous access to information on the status of any depositor's account. They also wanted to increase the speed and efficiency of service and desired to reduce the amount of paperwork involved in savings accounting and mortgage operations. Initially management in these cases examined the problem by answering the following questions:

Are there areas where masses of data are handled by a relatively large group of people? In the thirty years between 1920 and 1950, statistics reveal that the number of office workers increased by 150 per cent—a figure to be compared with an increase in production workers of about 50 per cent. The disproportionate growth of white and blue collar workers could be a reflection of improvement, i.e., labor productivity could have increased and an efficiently working clerical force could merely have increased to meet the growth of business. Even with this most favorable interpretation, it is apparent that as growth continues, with its pattern of increased wages, there is a limited size for an efficient clerical force. The problem is not one of simply finding means of reducing the clerical force, it is one of obtaining a more efficient and useful data handling operation. Thus, areas where masses of data are handled by a relatively large group of people are not bad per se, it is just that such areas are suspect as being inherently inefficient operations.

The record keeping function for B. F. Goodrich and Hood brands of footwear required more than 50 clerks. They determined that with an automated inventory control system this number

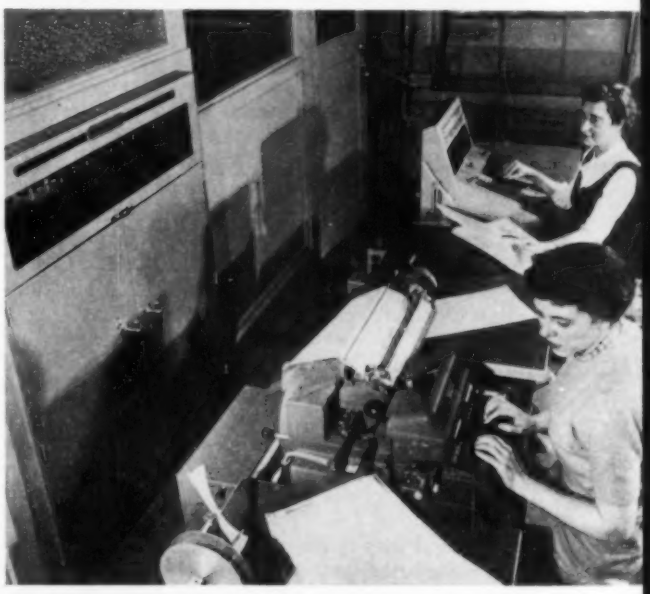


Fig. 2—Operator at supervisor's control console, rear, can check availability of warehouse inventory. Memory is queried from console; answer is shown on indicator display panel at left. Relationship of these pieces of equipment is shown in diagram of *Fig.* 1.

could be reduced to about 20. However, they regarded the installation of an automated system as an aid to efficiency and productivity rather than as a labor saving device and explored the possibility of transferring these clerks to other positions so that no loss of employment would result from the installation, *Fig.* 2.

The banks maintain masses of data covering account balances, interest computations, deposits, withdrawals, hold conditions, etc., in addition to maintaining the sizeable records connected with the mortgage function. A part of the record keeping functions were performed by the tellers through the use of ledger cards; in addition, a number of clerks were required to maintain central records connected with the mortgage operations.

Can these masses of data be reduced to specific requirements for an electronic data processing system? Given a large number of people inefficiently handling large quantities of data, it does not directly follow that business-type data processing equipment can be applied. The problem becomes one of investigating and simplifying procedures and developing routines for manipulating the mass of data.

B. F. Goodrich-Hood found that it was possible to establish specific requirements by a combination of standardization of paper forms and work flow. The banks also were able to reduce masses of data to specific requirements and in doing so they were able to streamline their operation. In one instance, savings of almost $100,000 a year were effected through preparing the operation for the electronic data processing service.

What type of equipment, special purpose or general purpose, may be applied to the problems? In varying degrees, data manipulation involves such factors as: Arithmetical operations, data sorting, data collating, making of logical decisions, report printing, etc. Use of general purpose equipment typically anticipates the factor of change and emphasizes the value in being able to vary routines for a range of data handling problems. Use of special purpose equipment recognizes that data handling requirements might be so well defined that it is feasible to use tailor-made equipment rather than pay for capabilities that are known to be unnecessary.

Hood approached this question on the basis of "is there a production model machine for a system that can do this job?" Among other requirements they needed special input devices and an instantaneous readout and display of information. They determined that it was not possible to get this with a standard machine and that they had to have equipment specially designed to meet those requirements.

The savings banks also needed special teller machines to be tied into the central data processor and had a further requirement that these machines might be located at branch banks miles away from the main office. For this reason the banks also had to go to specially designed equipment, *Fig.* 3.

Which type of equipment is preferred—general purpose or special purpose? The answer here is that equipment should meet the requirements of the problem. Its choice should not depend upon some preconceived notion as to supposed merits of different types of equipment. Deciding this question should only follow a detailed analysis of a specific set of circumstances when related to the best anticipation of future conditions. Historically, general purpose machines have been regarded as completely flexible while special purpose machines have been thought of as having a wired program and being rigidly limited to the functions for which they were intended.

The B. F. Goodrich-Hood machine is one in which added functions are not within the capabilities of the design. This machine was designed to perform functions which were specified by the customer through his consultant and operating management; it is a wired program machine quite special purpose in nature.

The system provided for the banks, on the other hand, is an extremely flexible stored program machine. This flexibility is provided in recognition of the continuously changing requirements in the banking operation as exemplified by various interest calculating rates and methods. A further requirement—that of mortgage processing—encompasses all of the facets of accounts receivable and receipt of payment problems found in the normal commercial enterprise. However, the system as a whole is truly special purpose or tailor-made because of its unique window machines at each teller's position and communications net that ties branch operations together. This flexible stored program machine is highly desirable in terms of future growth

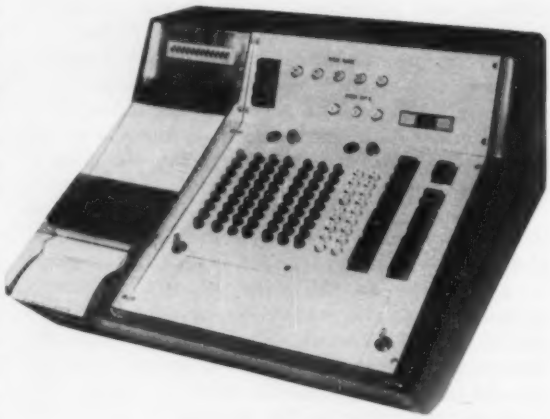


Fig. 3—This is part of special equipment designed for bank applications by Teleregister Corp. The Teller machine automatically prints entries into a pass-book, improving operations by eliminating manual postings and attendant record transactions.

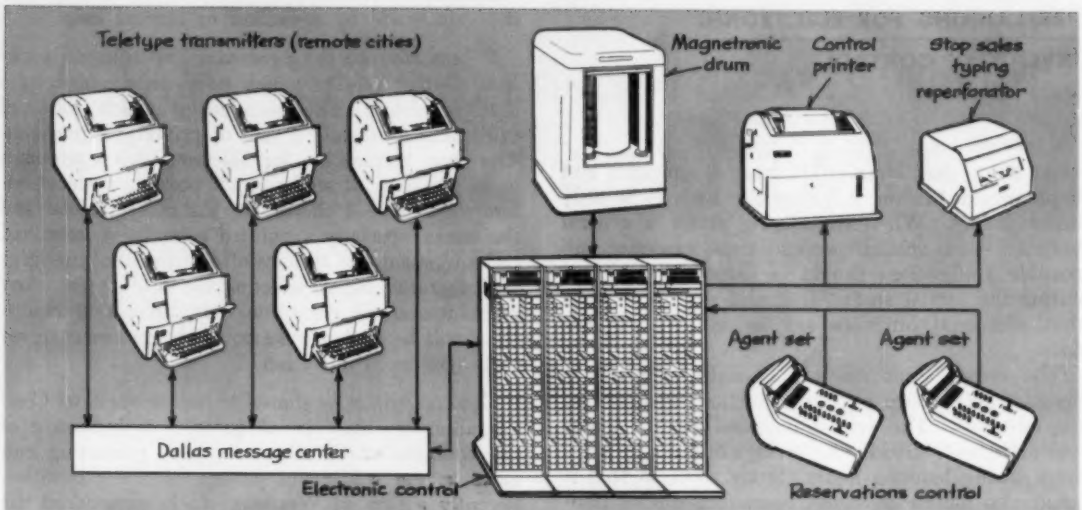


Fig. 4—Airline reservation clerks in various cities can directly query central records inventory in Dallas with use of teletype messages. As messages are received, they are punched on tape and automatically fed by tape readers into an electronic control and memory drum. If space is available, drum is updated. When flights are filled, data are automatically generated to advise all offices of that fact.

and changes in operational methods.

What justifications exist for the projected expense of the computer? Cost saving factors which can be considered at this time include: Improvements possible because of faster recording; reduced personnel requirements; reduced errors; and better customer relations. Whatever an initial appraisal might show, only a detailed analysis as related to a specific system can be used to intelligently evaluate the factors.

Reduction in costs due to faster recording. B. F. Goodrich-Hood found that information could be made immediately available which would enable them to plan production according to the urgency of current demands. This meant that their production planners did not run the risk of scheduling manufacturing to meet apparent shortages when, in actuality, the shortages might not occur for several months. Substantial savings could be effected by preventing overproduction with resultant inventory of styles that might be out of date the following year.

The banks determined that they could instantaneously update account status; in addition, they were able to take advantage of automatic computation of interest at the end of the period instead of making a daily projection.

Reduction in personnel. In all cases they found that they would reduce personnel in certain areas and that these people could be absorbed in other operations in the company, without overstaffing, due to normal personnel fluctuation.

Reduction in clerical errors. With the manual system at B. F. Goodrich-Hood, filled out forms were accepted as gospel, yet obviously they were subject to human errors. Once this information was entered in the central records it was virtually impossible to locate a discrepancy known or suspected to have occurred. They found that with an automatic system they could verify all input information before this information was acted upon.

As far as the banks were concerned, account number verification was provided for the teller and there was no possibility of an error in picking up the old balance since this was provided automatically by the data processor.

Better customer relations. The delays inherent in the manual inventory system of B. F. Goodrich-hood resulted in time delays in advising the customer as to when he might expect shipments and whether it would be a full shipment or a partial shipment. By having this information immediately available the customer can be notified without delay.

In the banks, through the elimination of ledger cards and the necessity for tellers having to refer to them before manually posting such information as interest, the time required to serve a customer was considerably reduced. Moreover, with the use of the electronic system it was no longer necessary for the customer to go to the one window alphabetized for his name. This distributed customer lines evenly, thus speeding up service. The elimination of ledger cards also provides more space for customer use.

Are there additional functions in other areas that can be handled by the data processing equipment? Automation in any form should be the result of a thorough study of the entire system being investigated for improvement. Implementation of a program can be accomplished on a piecemeal basis in

some cases—but both establishing a program and implementing it on a piecemeal basis will only invite failure. When considering either a general purpose or a special purpose data processor, all possible applications should be examined in detail during the formal study. It should not be assumed that additional functions can be added at a later date.

The system built for B. F. Goodrich-Hood was designed to perform only the functions specified by the customer. The system provided for the banks was designed to handle the savings accounting functions during banking hours. Study revealed that it could also handle mortgage operations during non-banking hours.

Should the equipment handle future growth of present operations? Regardless of what type of system is employed the answer to this question must be affirmative, based on a projection of the company's growth possibility. The procedural part of data handling is normally defined within the company and subject to management control. This being so, the problem of allowing for future growth is primarily a quantitative one of anticipating what growth might do to volume of data handled.

What complications in costs will arise in converting from our present procedures? Will there be an interruption of service in making the change-over? In order to convert from a manual to an automatic system it is usually necessary to operate both systems at the same time for a period of as much as 2 or 3 months. This enables the personnel to familiarize themselves with the new operation, assures the transfer of all of the information from a manual to the automatic system, and provides a check period for determining that the system performs all of the functions required of it.

What physical modification to plant and equipment will be needed to install the data processing system? It should be remembered that today most large systems employ vacuum tubes and require air conditioning. This not only calls for an expensive installation but also results in a sizable increase in the amount of power consumed; expensive wiring and cabling is usually necessary. These air conditioning and power requirements will be reduced substantially as transistors replace vacuum tubes. In the event that the customer wants to use the computer as a show piece some structural changes to the building may be required so that an attractive setting may be provided.

How many programmers will be needed and what will this payroll amount to? Special purpose systems programmed by the equipment manufacturer require no programmers in the user's plant. However, the payroll factor for programmers for general purpose machines may in some instances offset the gain made by reduction in clerical help.

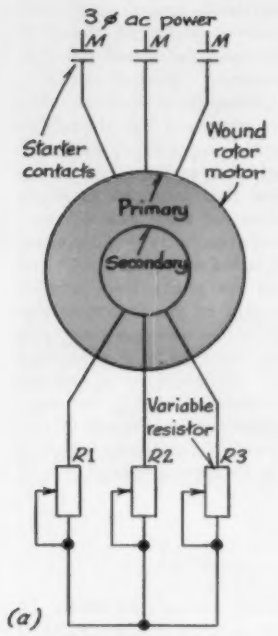
Where may we see a machine operating on problems similar to ours which have been solved by a data processor? The question of which piece of equipment to install is one of primary importance. The men responsible for selecting this equipment must give careful study to all possible systems before they make a choice. In the case of Hood and the banks, specially appointed committees examined the equipment and systems offered by all of the large manufacturers before selecting the final system. Any manufacturer of electronic data processing equipment will be glad to take potential customers to see their systems in operation.

Can the system be shared to reduce the cost? Consideration of this type of question is indicative of the changes which electronic data processing can make in the traditional pattern of doing business. Recently a firm in Westbury, L. I., announced the formation of a service company to provide data processing to industries in that area. They will perform such functions as payroll, inventory control, calculation of schedules, analyses of price structure, the development of quality control data, statistical analyses, and complex engineering calculations. Three insurance companies in Hartford, Conn., have grouped to share the services performed by an International Business Machines Corp. 705 machine. The Teleregister Corp. has announced that its savings bank system can be shared by a number of banks without any bank having access to any information about its competitors.

Once the men responsible for the selection of the automatic data processing equipment have reviewed these basic preliminary questions for their particular operations they will then be in a position to sit down with individual manufacturers of data processors and go into a more thorough cost justification study. During the course of this study they can evolve requirements of the equipment and then determine what system will best fulfill these functions.

Cost justification should not be the main consideration in determining that an automatic data processing system should be installed; increased efficiency, greater speed, and better customer relations also may not be complete justification for a change-over from a manual operation. Rather, firms considering a change should check for unique situations which in themselves might justify such an installation. For example, by installing a special purpose electronic system, one bank was able to justify the postponement of construction of a new building for 10 years.

Airlines and hotels have found that with heavier loading of aircraft and maximum reservation of rooms made possible with instantaneous information on availability there is considerable increase in income with no additional expense, *Fig.* 4. The problem should be approached with the basic concept that it will not necessarily be cheaper to perform the operation per se through the installation of automatic data processing systems but that a more efficient data handling system might be obtained.

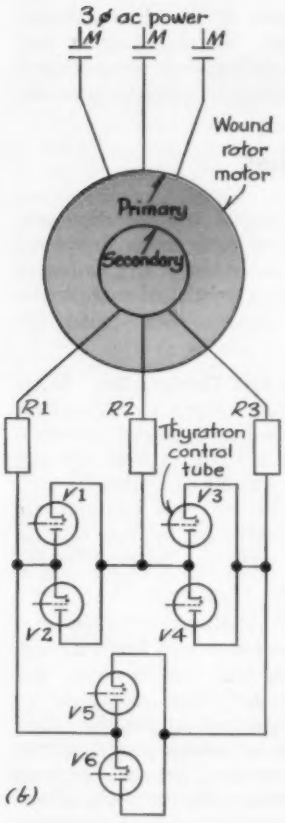


CONTROL CONCEPT CREATES VERSATILE

AC ADJUSTABLE SPEED DRIVE

Increasing numbers of automatic machines and processes require the flexibility and precision of operation possible with adjustable speed drives. The venerable wound rotor motor, equipped with modern controls and closed-loop regulating means, is proving an economical and satisfactory choice for many of today's adjustable speed drive applications.

By CLARENCE MARX and HERBERT DESSMER
Chief Engineer, Electrical Engineer
Electric Products Co., Cleveland, Ohio



WOUND ROTOR motors have long been recognized for their ruggedness, low-current high-torque starting characteristics, and adaptability to varying speed use where regulation is relatively unimportant. The convenience of ac operation has also contributed to their popularity. Because of these useful properties, they are employed throughout industry in sizes from fractional to many thousands of horsepower, often in very difficult service.

However, as normally applied with adjustable or fixed resistances in their secondary circuits, *Fig.* 1*a*, they have varying rather than adjustable speed characteristics. In other words, speed varies widely with load, and their performance is not satisfactory for many of today's applications that call for good regulation and flexibility of adjustment.

Improved Performance

Modern advances in electronics, sensing, and control technologies, however, promise to overcome this disadvantage and thus extend the utility of this type of drive. A variety of wound rotor motor control schemes devised by Electric Products Co. illustrates what can be done to compensate for some of the undesirable characteristics of the basic motor.

By introducing thyratrons in the secondary circuit of such a motor, *Fig.* 1*b*, the torque-speed characteristics can be controlled over a wide range of operating conditions. For example, in an adjustable speed system,

Fig. 1—Schematic diagrams illustrate basic conventional 3 phase wound rotor motor circuit, *(a)*, and thyratron-controlled circuit, *(b)*. Addition of thyratrons to resistance legs provides sensitive means of control of torque-speed characteristics of motor. Thyratrons conduct when their plates are positive with respect to their cathodes and grid bias is below cutoff value. By controlling grid bias, any desired portion of ac cycle induced in motor secondary by primary can be allowed to produce torque. Back-to-back connections of thyratrons in each resistance leg enable control of both half-cycles of ac sine wave in secondary.

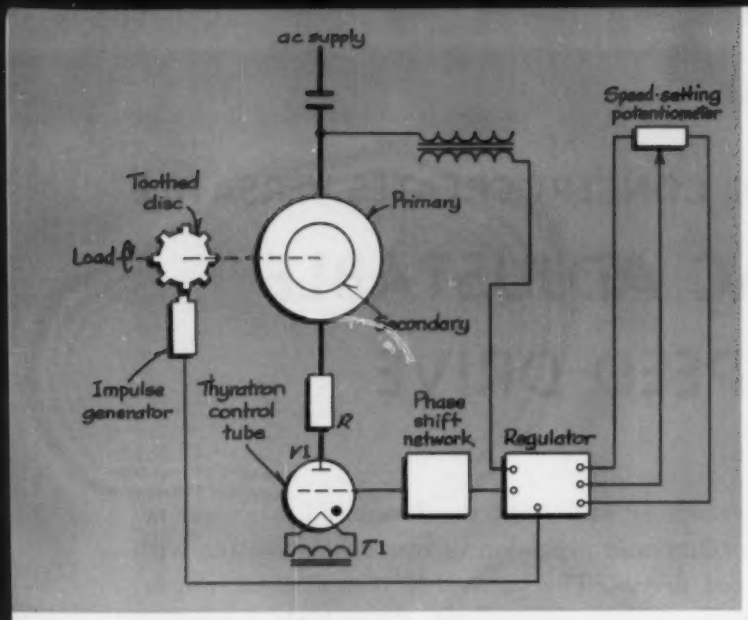


Fig. 2—Simplified one-line diagram illustrates elements of an adjustable speed setup that combines basic thyratron-controlled circuit of *Fig.* 1*(b)* with components for speed selection and feedback regulation. Desired speed is preset on a speed setting potentiometer. This action establishes a command signal level in the regulator. Signals proportional to actual motor speed are fed back to the regulator by an impulse generator that responds to motor shaft rpm. Comparison of these two signals—command and actual—results in a difference, or error, signal that is fed to a phase shift network. Signals from the phase shift network are applied to the grid of the thyratron and determine the point in the secondary ac cycle at which thyratron conduction begins and torque is generated. As the motor speed approaches the speed reference setting, the regulator automatically governs the amount of secondary current to provide only enough torque to drive the load at the desired speed.

Fig. 2, the basic wound rotor motor thyratron-control setup is combined with speed sensing and regulating means to automatically hold a selected speed virtually constant regardless of severe load fluctuations. Control actions are described in *Fig.* 3 and performance capabilities of a drive of this type are shown in *Fig.* 4.

A design feature, *Fig.* 5, available in wound rotor motors made by Electric Products Co., further improves the operation of the motors. An integral fan rotor assembly, mounted so that it can rotate independently on the motor shaft, operates on leakage flux produced in the motor end windings. This normally undesirable flux is produced unavoidably, and results from the necessity to bring the coil turns of both the primary and secondary windings of a wound rotor motor some distance out from the ends of the iron cores before they can be returned. The advantage in using leakage flux to turn the fan rotor assembly lies in the fact that the strength of this flux is proportional to motor current. Thus, at heavy loads and low speeds, more torque is developed to turn the fan rotor, and cooling action is automatically increased.

▶ Variety of Controls

It should be emphasized that the basic circuits described illustrate design concepts more than distinct products. Installations vary with the requirements, and some may call for saturable reactors instead of thyratrons, or transducers that are responsive to process variables in place of a speed setting potentiometer. Tension, position, pressure, and flow transducers, for example, can supply command signals to vary motor speed in accordance with process needs.

Feedback signals indicative of actual motor speed likewise can be provided by a variety of means. Impulse generators, ac or dc tachometers, and motor secondary voltage or frequency can all be used. In the case of the latter, speed sensing is accomplished through secondary voltage or frequency, both of which are inversely proportional to speed.

Reversing, jogging, creeping, and braking provisions are also readily included in complete drive systems. Braking may be purely electrical or by solenoid-released mechanical brake. Jogging speed can be separately adjustable so that it is different from normal startup speed. Starting, jogging, and creeping are accomplished through low power control circuits without the operation of power contactors.

▶ Many Industrial Uses

With the flexibility of control and operation possible, these improved wound rotor motor drives are adaptable to many jobs in industry. A listing of some of the operating characteristics of such drives, and typical uses, will suggest their broad applicability:

Controlled Acceleration and Deceleration. Many continuous processing and conveying operations must be brought up to speed and stopped smoothly. Feeding of metal, paper, and plastic webs through processing machines, and starting and stopping conveyors without toppling the conveyed material, are examples of operations controlled by this type of drive. Adjustable acceleration can be provided for centrifuges.

Adjustable Speed. Metalcutting operations that require different speeds for rough and finish cutting, as well as rapid traverse and feed motions, can make effective use of wound rotor motor drives. A lathe application is illustrated in *Fig.* 6. They are also used to provide adjustable speed within a range for wood pulp grinders, pumps, crushers, calenders, and punch presses. In extrusion of insulation on conductors, the thickness of insulation

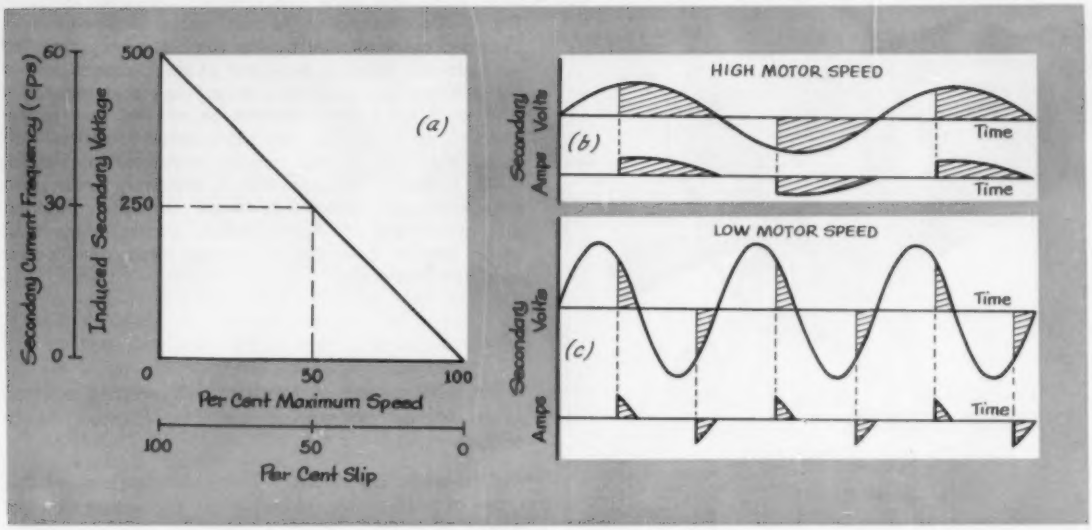


Fig. 3—Secondary current frequency and induced secondary voltage for a wound rotor motor are directly proportional to slip, and hence inversely proportional to per cent maximum speed, (a). Ordinate values given are typical for a 3 phase, 60 cps, 440v motor. At high motor speeds, secondary frequency and voltage in each phase winding are relatively low, (b). At low motor speeds, frequency and voltage increase, (c). Shaded areas of curves represent portions of cycles during which thyratrons are conducting and thus permitting development of motor torque. These areas can be varied automatically by feedback to extend from zero to a complete cycle, depending upon load requirements. Once they are made to conduct, the thyratrons will remain conducting until completion of the half-cycle during which conduction was initiated, even though bias is increased beyond the cutoff value before the end of that half-cycle.

is a function of wire speed and extruder screw speed—both are commonly made adjustable.

Each phase of a multistep operation may require a different speed. For example, a wound rotor motor driven knitting machine for hosiery might operate at a different speed for each of several phases of the process for producing a single item.

Speed synchronizing is possible by a variety of control means. In one version, several motors are controlled by a single thyratron unit, and follow the speed command signals from a speed setting potentiometer or a tachometer generator driven by a preceding or succeeding section of a process machine. In cases where individual speed trimming is required, each motor in the system is provided with a separate thyratron controller.

In the pumping and/or metering of corrosive or erosive materials, a great deal of downtime can be eliminated by reducing pumping speeds to the minimum required to remove the material. Furthermore, expensive valves and their controls can be eliminated if the pump speed is made responsive to flow, pressure, or other process variable.

In the training of operators, or pacing of production lines to accommodate different numbers of workers, the ability to change individual machine or complete line rates is a valuable asset. Adjustable speed is also useful in test stands for simulation of field conditions.

Positioning Control. Coarse positioning requirements of hoists are readily met with this type of

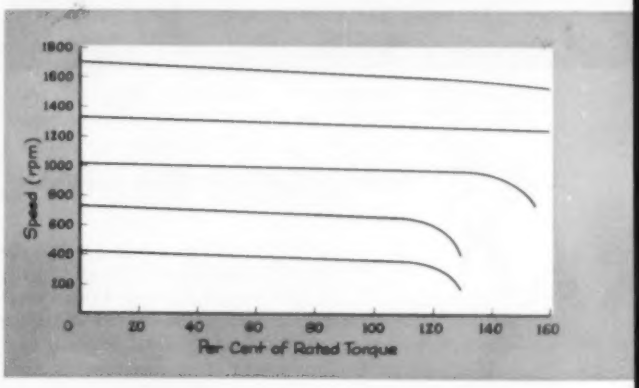


Fig. 4—Speed-torque curves illustrate performance capabilities of a 5 horsepower adjustable speed drive. Regulation is good for all speed settings. Droop in speed at excessive load torques at low speeds is induced by an optional current-limit feature to prevent damage to product, machine, and drive.

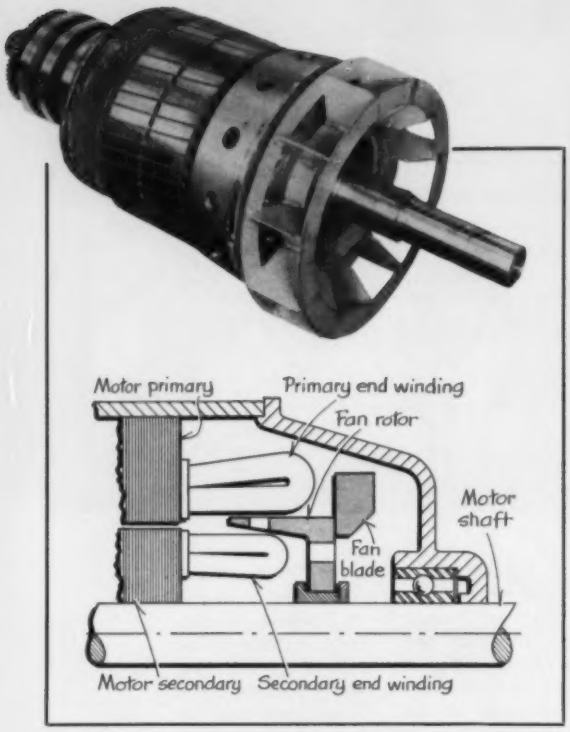


Fig. 5—Cooling action to suit motor requirements is provided automatically by fan rotor assembly mounted on separate bearing on motor shaft. Rotor is turned by leakage flux generated in primary and secondary end windings. Since magnitude of this flux is dependent upon current, fan rotor speed increases with load, providing greater cooling action when needed. At light loads, leakage flux is relatively weak and rotor turns more slowly against air resistance. Toothed disc at left end of shaft in photo rotates in the field of an impulse generator to provide rotor speed pulses used for feedback.

drive. By means of jogging and creeping control, more precise positioning can be obtained, as in machine tools.

Automatic Operation. The ability to control this type of drive by closed-loop regulating means qualifies it for use in a virtually endless variety of process applications. Speed changes are readily effected by signals from switches, thermocouples, pressure or force transducers, or almost any type of electrical or mechanical signal. Rapid response of the thyratrons to error signals enables closer control than is possible by varying large adjustable resistors through mechanical linkages. Since the motor can be direct-coupled to the load, change of speed is more rapid than can be obtained by shifting gears or changing belts.

▶ Production Gains

It is unquestionably true that great production economies can result from proper applications of controlled speed drives. In many cases, production increases and reductions in maintenance obtainable through their use make them an economical choice over other types of drives.

Fig. 6—Wound rotor motor, thyratron-controlled drive on this lathe permits frequent starting, stopping, inching and jogging, and continuous operation at various speeds. Generator rotor being machined must be rotated at low speed for rough cutting and high speed for finish cutting of commutator. Banding requires high torque at extremely low speed. Jogging and inching features are employed to position commutator bars for undercutting.

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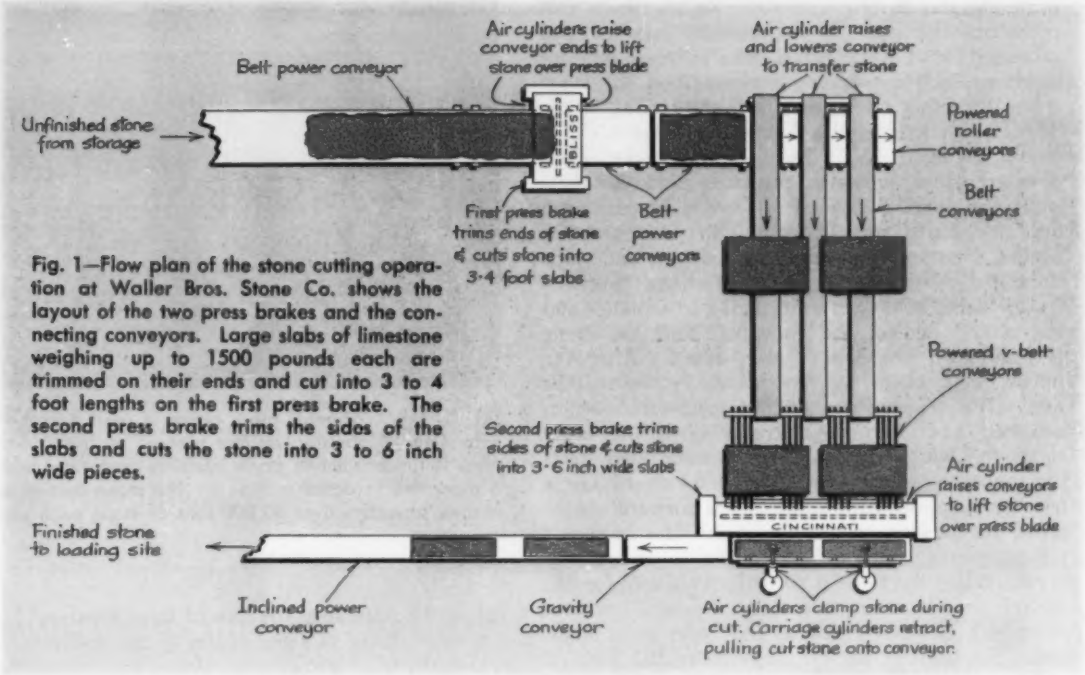

Air cylinders raise conveyor ends to lift stone over press blade
Air cylinder raises and lowers conveyor to transfer stone
Belt power conveyor
Unfinished stone from storage
Powered roller conveyors
Belt conveyors
First press brake trims ends of stone & cuts stone into 3-4 foot slabs
Belt power conveyors
Powered v-belt conveyors
Second press brake trims sides of stone & cuts stone into 3-6 inch wide slabs
Air cylinder raises conveyors to lift stone over press blade
CINCINNATI
Finished stone to loading site
Inclined power conveyor
Gravity conveyor
Air cylinders clamp stone during cut. Carriage cylinders retract, pulling cut stone onto conveyor.

Fig. 1—Flow plan of the stone cutting operation at Waller Bros. Stone Co. shows the layout of the two press brakes and the connecting conveyors. Large slabs of limestone weighing up to 1500 pounds each are trimmed on their ends and cut into 3 to 4 foot lengths on the first press brake. The second press brake trims the sides of the slabs and cuts the stone into 3 to 6 inch wide pieces.

APPLYING PNEUMATIC CONTROL IN A

MECHANIZED STONE CUTTING PROCESS

INCREASING DEMAND for different types of industrial and building stone has made it necessary for producers to find faster and more economical methods of preparation. Until recent years, stone was cut manually using hammer and chisel methods which date back to the days of the construction of the first pyramid. Previous attempts to mechanize stone cutting have met with some success, but equipment breakdown was frequent and installation costs have been high.

A simple but efficient stone cutting operation employing pneumatic control devices has been developed by the Waller Bros. Stone Co., McDermott, Ohio, in co-operation with the Ross Operating Valve Co. The pneumatic systems, combined with two mechanical press brakes and conveying equipment, enable two men to trim and cut tons of stone in less time than it previously took six men to score and fracture a single piece of stone. This is a significant increase in efficiency for this plant which processes over 30,000 tons of stone each year.

The trimming and cutting operation processes stones weighing 1000 to 1500 pounds at the beginning of the operation. Before cutting, the stones are in 8 to 12 foot lengths, 16 to 30 inch widths, and 2 to 7¾ inch thicknesses. The process trims and cuts the large stones into 3 to 4 foot lengths and 3 to 6 inch widths for use in building construction, for lining of industrial furnaces, and for stone tops and sinks for laboratory equipment.

First Press Brake Operation

At the beginning of the mechanized stone cutting operation, a large slab of Scioto sandstone is loaded onto a powered belt conveyor leading to the first

trimming and cutting operation, *Fig.* 1. From this point on, the stone is mechanically handled and processed until it is loaded into railroad cars for shipment. First operation performed on the stone is the trimming of the ends and the cutting of the 8 to 12 foot lengths into 3 or 4 foot lengths. This occurs in an E. W. Bliss Co. press brake. The powered conveyor moves the stone into the press until the leading edge of the stone is positioned over the lower press blade. The press operator pushes a button which stops the conveyor and starts the upper press blade to cycle down toward the stone. At the same time, an air cylinder is actuated and lowers the end of the conveyor until the stone is resting on the bottom press blade. After the upper press blade has completed its downstroke and is on its upstroke, the air cylinder is again actuated and lifts the conveyor until the stone clears the bottom blade. The operator then starts the conveyor again to move the stone forward 3 or 4 feet for the next cut. During this forward movement, the leading end of the stone rides onto another powered belt conveyor on the exit side of the press. When the stone is properly positioned for the second cut—a center cut this time—the operator stops both conveyors, and, as the upper press blade cycles for the cut, air cylinders lower the ends of both conveyors until the stone is again resting on the lower blade. After the cut, both conveyors lift the stone over the bottom blade. This operation continues until the entire stone has been cut into smaller slabs, and the trailing edge of the last slab has been trimmed.

As each short length emerges from the exit side of the press, the press operator controls several powered conveyor lengths to position the slab for a right-angle change of direction. This is done by riding the stone over the tops of three depressed belt conveyors lying at right angles to the conveyor on which the stone is traveling. When the operator has two stones lined up at the transfer unit, he actuates an air cylinder which lifts the three belt conveyors into contact with the stones and moves the stones in the new direction toward a second press brake. The stone is now traveling with its untrimmed side forward.

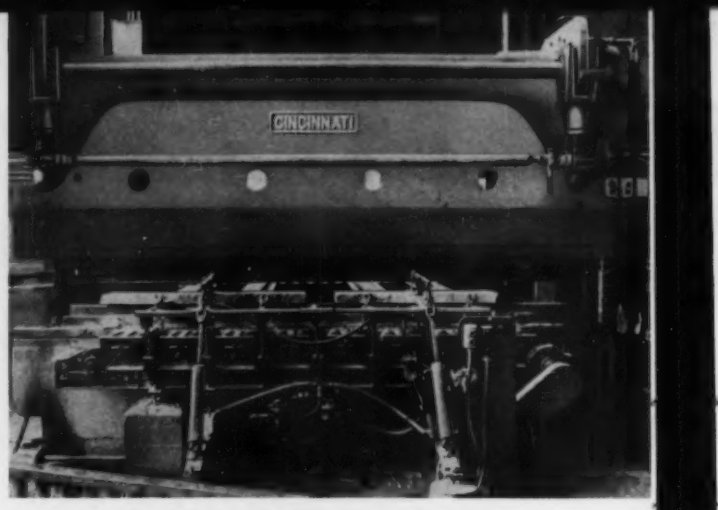


Fig. 2—This Cincinnati press brake is used to cut the 3 to 4 foot slabs into smaller pieces. In front of the press is the pneumatic stone handling apparatus which is described in detail in *Fig.* 3. The stone cutting operation processes over 30,000 tons of stone each year.

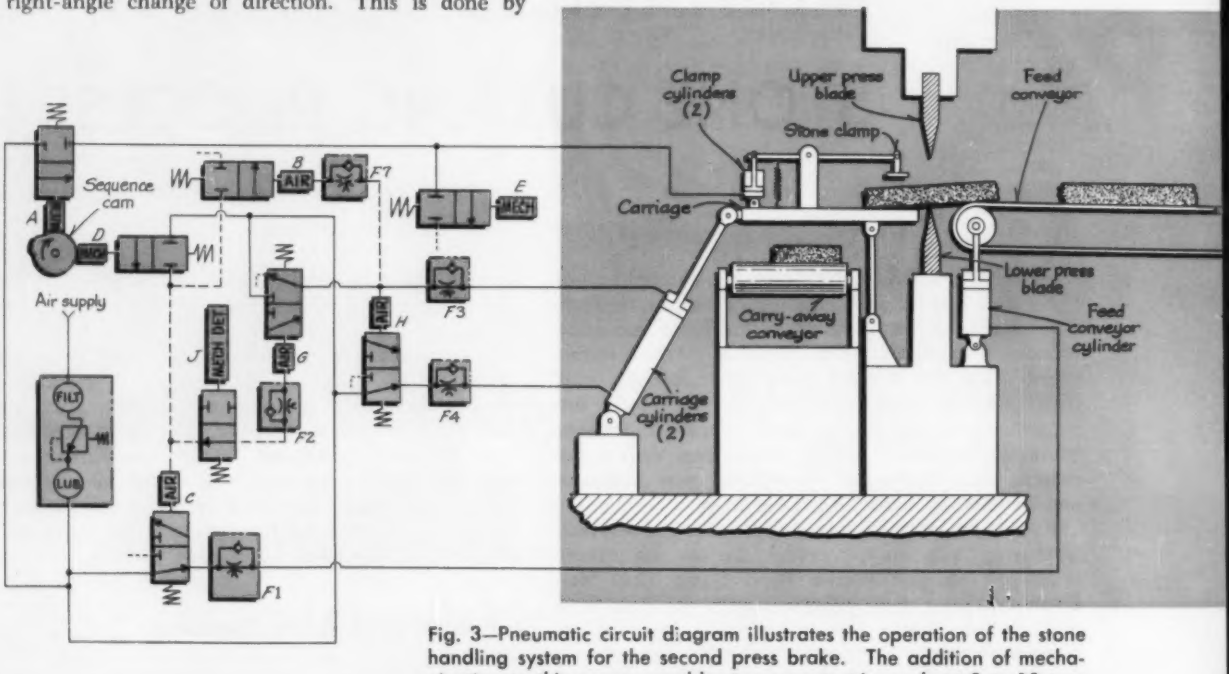


Fig. 3—Pneumatic circuit diagram illustrates the operation of the stone handling system for the second press brake. The addition of mechanization to this process enables two men to trim and cut 8 to 10 tons of stone per hour. A previously used manual process required several minutes and six men to score and fracture a single piece of stone.

▶ Second Press Brake Operation

The second press brake, *Fig.* 2, is controlled in a different manner than the first. Its operation is shown diagrammatically in *Fig.* 3. Another press operator is in charge of this operation which trims and cuts two stones at one time. The leading edges of the stones are trimmed in a similar manner as on the first press, using the principle of an air cylinder lowering the conveyors until the stones rest on the bottom blade of the press. After the trimming operation, the operator moves the stones foward 3 to 6 inches for the second or center cut. At this point, a cam, actuated by the movement of the upper press blade, initiates the operation of the circuit shown in *Fig.* 3. This circuit pneumatically clamps the protruding piece of the stone to a carriage; causes an air cylinder to lower the feed conveyor until the stones are resting on the bottom blade; and, when the cut is completed, causes the carriage to pneumatically retract and deposit the cut stones on a powered carry-away conveyor for movement to storage or railroad car loading.

At the present time Waller Bros. are continuing their automation program by developing a further refinement in the production of cut stone. A new piece of equipment will be connected by powered conveyors to the carry-away conveyor of the second press. After the stone has been cut into small slabs, the carry-away conveyor will either move the stone to storage and shipment in one direction, or, by reversing the conveyor, move the stone to an additional finishing operation. This operation will automatically chip the top surface of the stone to give a rough, hand-hewn finish. A pilot machine is now in operation, and is being thoroughly tested prior to building the final machine.

PNEUMATIC CONTROL SYSTEM FOR SECOND PRESS

STEPS in the movement and control of the stones being cut in the second press brake can be followed by reference to the pneumatic circuit diagram in *Fig.* 3.

Startup Condition. After the leading edges of the two stones in the press have been trimmed, the operator starts the feed conveyor which moves the stones into position for the second cut. At this point in the sequence, all pneumatic components are in operating positions shown in the diagram. When the stones have been properly positioned, the operator stops the feed conveyor and initiates the cutting stroke of the press.

Clamp Stones. As the upper press blade starts its downward stroke, a sequence cam on the press rotates and momentarily strikes mechanical actuator of valve *A*, opening the valve and admitting supply air to the blind ends of two clamp cylinders, one for each stone. The pistons of these cylinders move toward their respective rod ends, and through mechanical linkage, clamp the stones securely against the carriage during the subsequent cutting operations. As the sequence cam continues to rotate, valve *A* is spring-returned to its closed position, maintaining pressure in the cylinders.

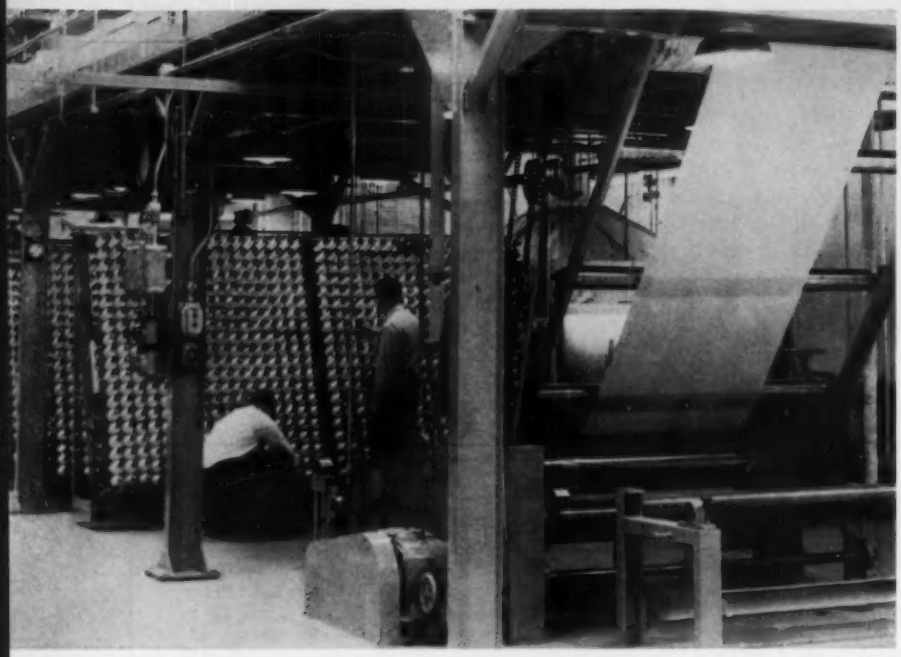
Lower Stones On Press Blade. The cam lobe next strikes the mechanical actuator of valve *D*, causing the spool of the valve to shift and admit supply air to the pilot of valve *C*. The spool of this valve shifts, allowing air in the feed conveyor cylinder to exhaust slowly through flow control valve *F*1. The weight of the stones on the conveyor causes the piston of this cylinder to move toward its blind end until the stones rest on the bottom blade of the press, ready to be cut.

Cut Stones and Retract Carriage. Cam-operated valve *D* also admits air to the pilot of valve *G* through the open port of manually-operated valve *J* and flow control valve *F*2. As the upper press blade cuts the stones and starts its upstroke, the spool of valve *G* slowly shifts and admits supply air to the rod ends of two carriage retraction cylinders through flow control valve *F*3. At the same time, valve *G* admits supply air to the pilot of valve *H* whose spool shifts and allows air to exhaust from the blind end of the two carriage cylinders through flow control valves *F*4. The carriage cylinder pistons then move toward their blind ends, causing the carriage to retract and move the cut slabs of stone from the press blades to the carry-away conveyor.

Unclamp Stones. As the carriage retracts toward the carry-away conveyor, it strikes the mechanical actuator of valve *E*, causing this valve to open and exhaust the clamp cylinders. Spring tension on the clamp lever arms forces the pistons toward their blind ends and lifts the clamp pads. The carriage then drops through slots in the carry-away conveyor, and powered rolls move the stones to the shipping area.

Return System To Normal. Valve *G* also admits supply air to the pilot of valve *B* through flow control valve *F*7. After a delay during which the preceding actions have occurred, the spool of valve *B* shifts allowing the pilots of valves *C*, *G*, and *H* to exhaust. The spools of these valves then spring-return to their startup position: Valve *C* admits air to the blind end of the feed conveyor cylinder, moving the piston toward the rod end and raising the conveyor slightly above the bottom press blade; valve *H* admits air to the blind ends of the carriage cylinders, causing the pistons to lift the carriage back to lower press blade; valve *G* exhausts the rod ends of the carriage cylinders and also exhausts the pilot of valve *B*, allowing the spool of this valve to be spring-returned to its closed position.

Cleaning Of Press. Mechanically-operated valve *J* is provided in the system so that the operator may manually close the valve, holding the carriage in place for the removal of stone chips.

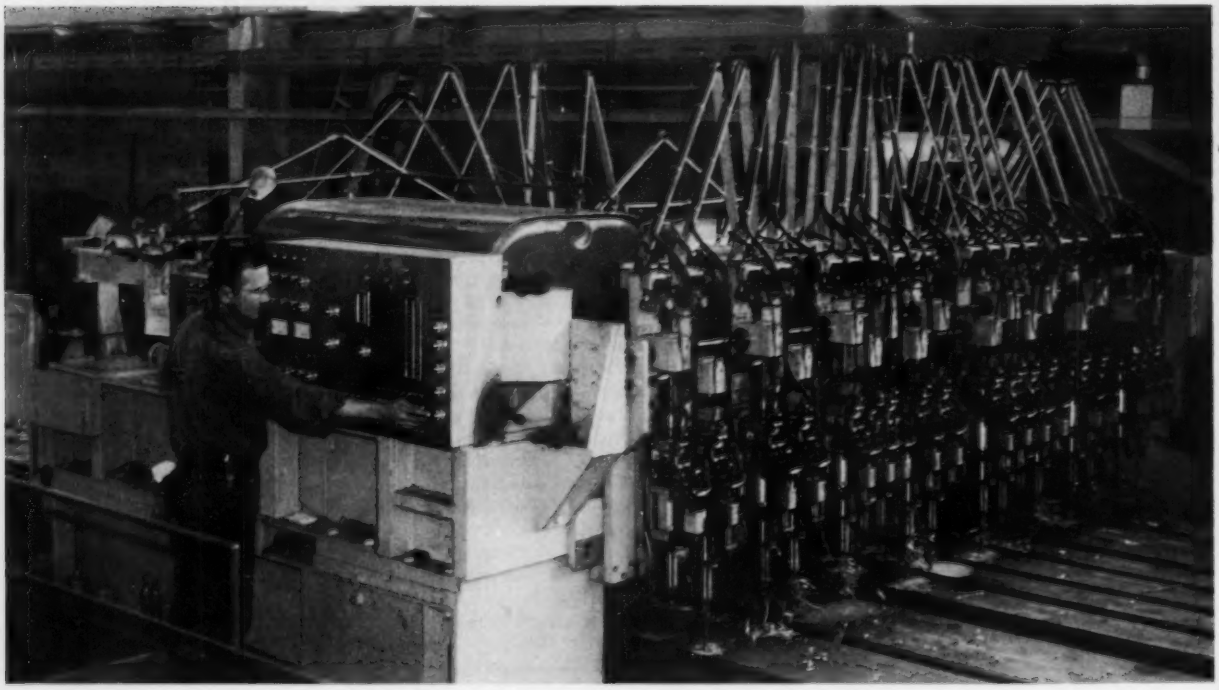


Combining Machine

UNIQUE equipment in operation at plant of Dutch Brand Div., Johns-Manville Corp., laminates parallel strands of material on flexible sheeting. Materials successfully joined in various combinations include: Glass fibers, paper, acetate, rayon, cellophane nylon, asbestos paper, cotton, rubber, aluminum foil, copper, mylar, and polyethylene. The machine can produce a finished product in widths up to 54 inches at rate of 700 yards per hour. Stranded material, fed from 4000 separate spools, can be placed at spacings ranging from 12 to 100 parallel strands per inch of width, depending upon properties desired.

Drilling Machine

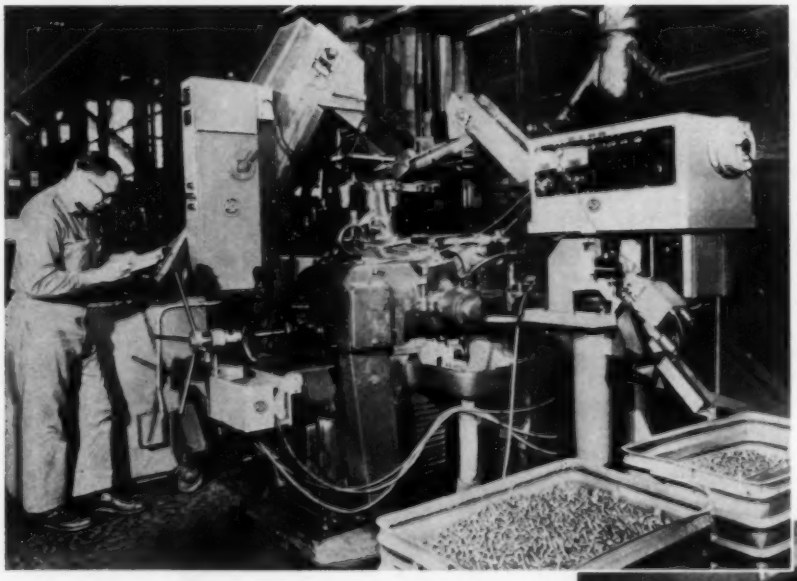
UNIT which can drill holes, singly or in groups, at varied locations on horizontal and vertical faces of structural steel shapes or plates has been developed by Lehigh Structural Steel Co. Twenty-seven standard drill units are used. Front side of frame carries 18 vertically mounted drill units; back side of frame supports five vertically mounted units and four horizontally mounted units. The drills can be directed to operate at desired locations extending over the 12½ foot wide by 120 foot long drill bed. The control system includes a direct reading tape system for each drill unit and the machine frame which operates on a track.



in action

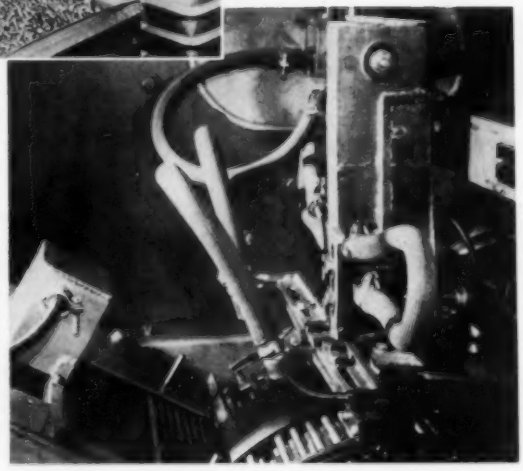
Stacker Crane

NEW plant of the Allen Mfg. Co. features a special stacker crane manufactured by the Louden Machinery Co. and "Christmas tree" racks for storage of bar and rod stock. The suspended crane unit, carrying one man, can move freely along any aisle of the racks, and up and down to reach a desired level. Bundles 12 feet long and weighing up to 6000 pounds can be handled.



Grinder Control

MAGNETS used in a variety of communications equipment are finished by a grinder at rate of 9600 per hour at the Spaulding works of the Crucible Steel Co. The automatic control system for the grinder was developed by Radio Corp. of America. Previously, one operator produced 4800 magnets per hour with all of tolerance checking done by hand. Under the automatic system, each magnet is gaged for proper size automatically, and oversize rejects are rerun through the grinder.



Induction Heater

HEAT treatment process has been installed directly into an automatic production line at a Chrysler Corp. plant. A General Electric Co. 25-kw electronic induction heater is continuously fed parts at rate of approximately 1800 rods per hour by a revolving drum conveyor. Both ends of the rod are exposed to water cooled inductors, are heated to required temperature, and are cooled in oil quench. The installation replaces previous process in which parts were sheared and shaped in one department and then sent to a heat treatment department for hardening.

AUTOMATIC CHUCKING UNIT SPEEDS GEAR GRINDING OPERATION

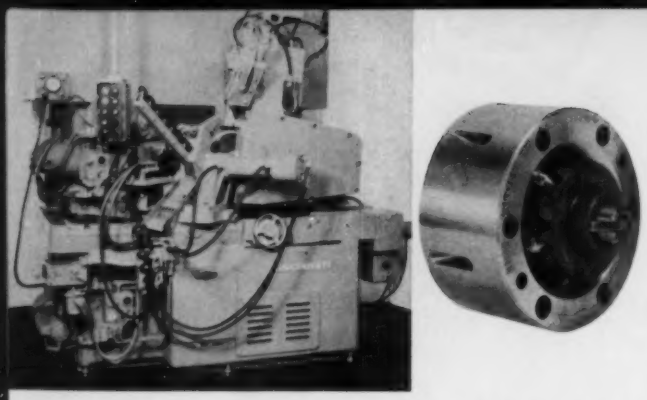


Fig. 1—Cincinnati Milling Machine Co. grinder is equipped with special Garrison Machine Works Inc. chuck that receives bevel gears from a magazine, locks them in place for grinding, and discharges them automatically to a hopper when the operation is completed. Loading and unloading are accomplished while the chuck is rotating.

THERE ARE many manufacturing operations in which parts must be accurately located and held in chucks for machining. When chucks are used in automatic machines, they are often called on to provide more than just locating and holding actions. For example, they must usually be designed to permit rapid, foolproof, automatic loading and unloading when used in such service. Also, productivity requirements of automatic machines frequently require that the chuck accept and eject parts while it is rotating.

A special chuck, *Fig.* 1, designed and fabricated by Garrison Machine Works Inc., provides all of these features in a mechanism that supports gears during a grinding operation. Used in a Cincinnati Milling Machine Co. grinder, the chuck receives bevel gears from a magazine, locks them in place during the grinding operation, and automatically ejects them into a hopper when grinding is completed. Details of operation of the chuck are illustrated in *Fig.* 2.

Transfer of gears to the chuck is effected by a pneumatically operated loading ram that engages a gear by its hub and removes it from a magazine. As the gear is loaded in the chuck, it passes over an extended clamp dog and a spindle until the teeth engage a flat spring type shedder. The shedder, rotating with the chuck body at a slow loading speed, imparts rotation to the gear. It also prelocates the gear with respect to fixed locating pins in the chuck body.

As the loading ram continues to advance the gear toward the chuck body, the shedder sleeve retracts into the body against spring pressure until the fixed locating pins engage the teeth of the bevel gear. The gear is thus located axially on the chuck in concentricity with the center of rotation. The shedder is locked in its retracted position by an internal locking arrangement.

When the gear is fully seated on the locating pins, a drawbar is actuated that causes the extended locking cam to retract, pivoting 90 degrees and locking the gear against the pins. The loading ram is then withdrawn, the spindle speed is increased, and the grinding wheel is advanced. A gaging device automatically controls the grinding operation and retracts the wheel when the proper size has been reached.

After grinding is completed, the drawbar is advanced, pivoting the clamp dog to its extended position to permit removal of the part. Forward movement of the drawbar also releases the locking mechanism for the shedder, and this element springs outward from the chuck body, discharging the gear to a hopper. The speed of rotation of the chuck body has been decreasing in the meantime, so that the chuck is ready to receive the next gear from the machine loader, speed up, and start the next grinding cycle.

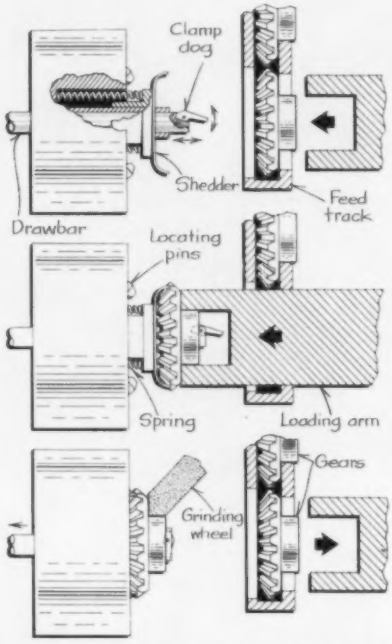


Fig. 2—Diagram illustrates mechanical details and operation of automatic gear chucking unit. Loading ram advances toward chuck and picks up gear from a magazine *(top)*. Gear rides over extended clamp dog, *(center)*. When gear seats against locating pins in chuck body, drawbar is retracted, locking clamp dog against gear and holding gear in place for grinding operation *(bottom)*. After grinding is completed, drawbar is advanced, extending clamp dog and allowing shedder to spring out and eject part.

Man's Eternal Struggle with the Machine

BUSINESS IS UNUSUALLY COMPETITIVE TODAY AS OPERATING COSTS ARE RISING AND PROFITS SHRINKING

Did you ever meet a vendor who wouldn't sell you the equipment you wanted?

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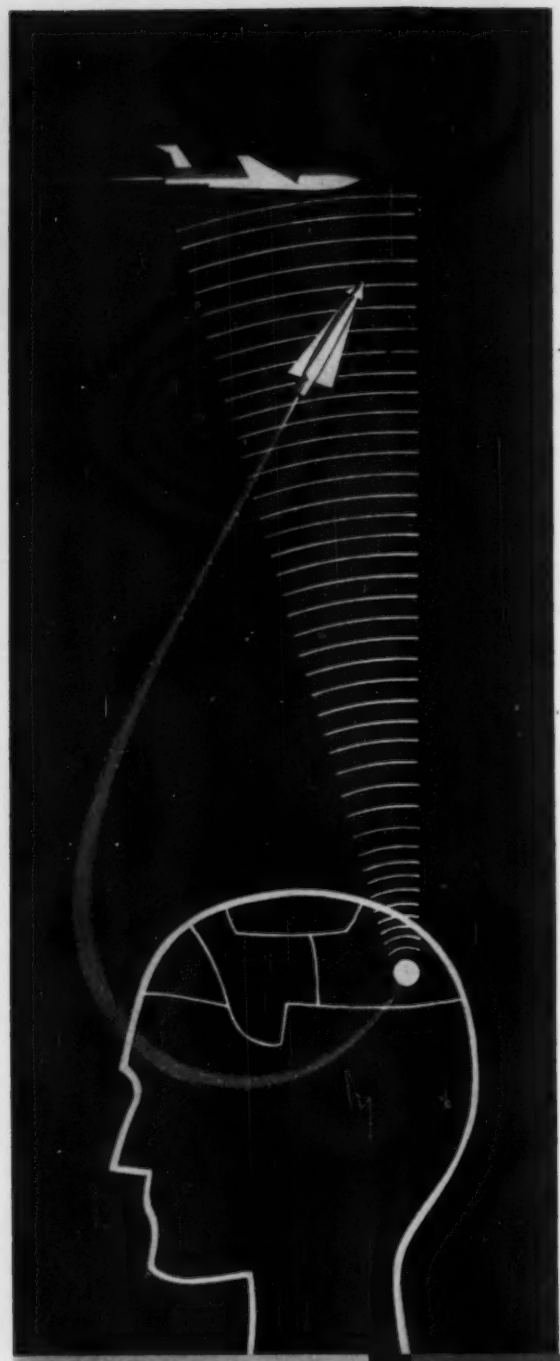


From Bell Telephone Laboratories...

Brainpower

for the brawny

Nike-Hercules

The Army's newest surface-to-air guided missile—the lethal Nike-Hercules—is now operational. Because it is, no unfriendly plane will be able to fly sufficiently high, fast or evasively to escape a fatal rendezvous with it.

For Hercules has a "brain"—an intellect that makes it a prodigy among today's electronic robots. Bell Telephone Laboratories developed it. Western Electric (prime contractor for the entire missile system) is producing it. Douglas Aircraft Company is giving it its body.

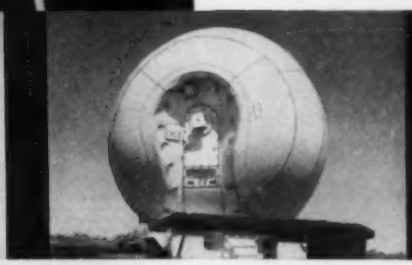
This "brain" is a fully integrated guidance system, almost entirely land-based. Only the vital signal-receiving apparatus is expendable within the missile itself. Other highly practical features: it defies "jamming," is completely mobile, is designed in separate "building block" units which are replaceable in seconds—and is deadly accurate.

Bell Labs scientists and engineers designed the world's largest and most intricate telephone communications network for the Bell System. They developed about half of the Armed Forces' radar equipment during World War II. And they pioneered the nation's *first* successful air defense guided missile system—Nike-Ajax.

They were eminently qualified to give Hercules the brainpower it needed.

BELL TELEPHONE LABORATORIES
World center of communications research and development

Vigilant acquisition radar for Nike-Hercules first detects approach of distant aircraft, pinpoints its location and instantly signals to battery control.

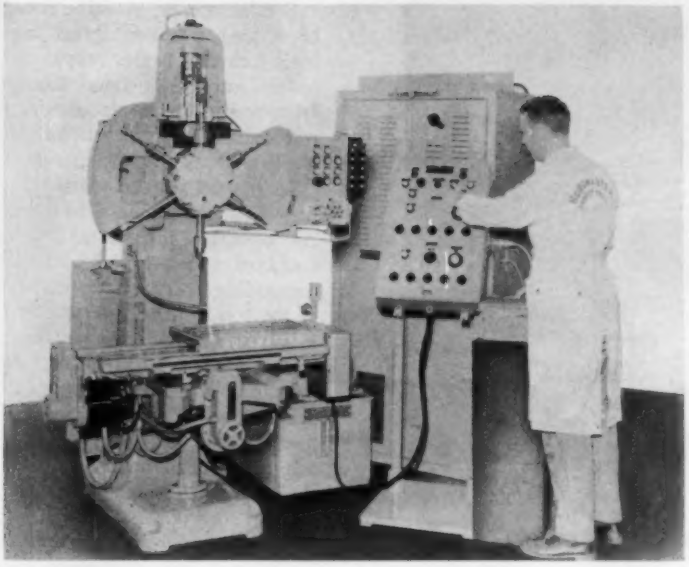


Two tracking-radar antennas, housed in radomes, take over. One feeds target azimuth, elevation, range data to computers; other tracks Hercules.

Two sets of radar data are electronically computed and plotted. Hercules is "steered" by radio signals, then detonated at precise point of interception.

AUTOMATION new equipment

Machines and plant equipment for more automatic operations
For detailed information and literature, use card page 147.



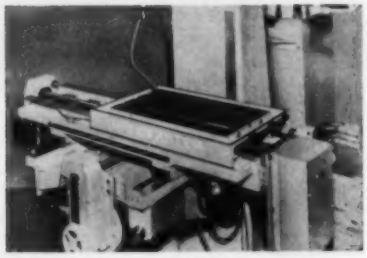


Table positioning within ±0.001-inch is effected through servo controls.

Punched Tape Controlled Machine Tool

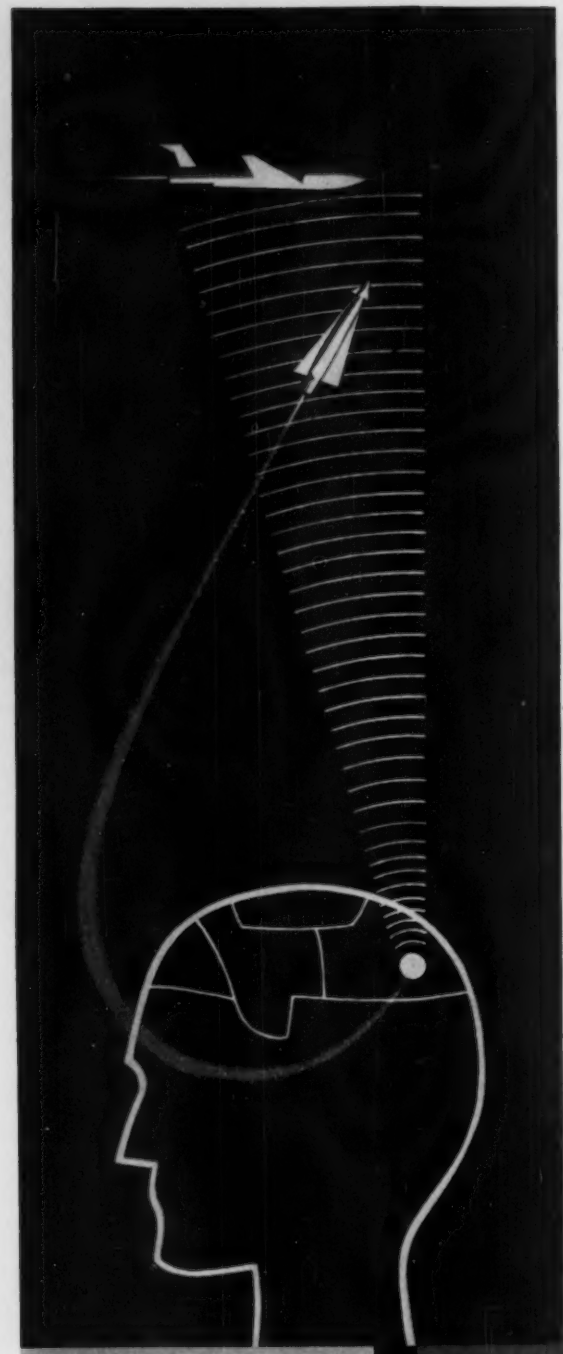
SHORT RUN machining can be automatically accomplished with punched tape control of a standard machine tool. Turret drilling, tapping, and boring machine, built by **Burg Tool Mfg. Co. Inc.**, 15001 S. Figueroa St., Gardena, Calif., is combined with a General Electric Co. numerical tape control to permit the machining of short production runs of different parts. The control system positions the table on two axes, indexes the turret in any sequence, clamps the table in position while machining operations are being performed, and controls auxiliary functions such as coolant flow, airblast chip removal, etc. The operations can include drilling, boring, tapping, reaming, counterboring, and spot facing.

When programming a part, a zero reference position is established, and all holes on the part are referenced to that zero and are so laid out on the programming sheet. The sequence of operations is laid out by using a machine spindle speed chart. One spindle can be cycled as many times as required before indexing to another tool, or all operations can be completed for a particular hole location before moving the table. The balance of necessary information, covering a record of the part; operation sequences; tool sizes; feeds; speeds; and auxiliary functions, is tabulated on the programming sheet. Using this sheet, the punched tape is prepared on a Flexowriter typewriter.

Flexowriter typewriter punches tape according to programming instructions.

Machine Control

There are three methods of controlling the operation of the machine—automatic tape control, dial control, and manual control. When the machine selector switch is set on *Automatic* operation, the table and turret carry through all operations on table location and spindle selection punched in the tape in the order selected. Up to six or eight operations, as well as a *Stop* command can be programmed for each *X* and *Y* position. When the *Stop* command is executed by the machine, an indicator lamp lights. Once the part is positioned, the table is locked in place by air clamps during all of the machining operations. The turret slide is locked out until the table is posi-



From Bell Telephone Laboratories...

Brainpower

for the brawny

Nike-Hercules

The Army's newest surface-to-air guided missile—the lethal Nike-Hercules—is now operational. Because it is, no unfriendly plane will be able to fly sufficiently high, fast or evasively to escape a fatal rendezvous with it.

For Hercules has a "brain"—an intellect that makes it a prodigy among today's electronic robots. Bell Telephone Laboratories developed it. Western Electric (prime contractor for the entire missile system) is producing it. Douglas Aircraft Company is giving it its body.

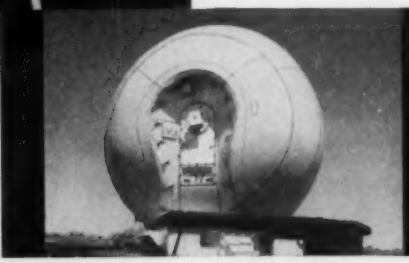
This "brain" is a fully integrated guidance system, almost entirely land-based. Only the vital signal-receiving apparatus is expendable within the missile itself. Other highly practical features: it defies "jamming," is completely mobile, is designed in separate "building block" units which are replaceable in seconds—and is deadly accurate.

Bell Labs scientists and engineers designed the world's largest and most intricate telephone communications network for the Bell System. They developed about half of the Armed Forces' radar equipment during World War II. And they pioneered the nation's *first* successful air defense guided missile system—Nike-Ajax.

They were eminently qualified to give Hercules the brainpower it needed.

BELL TELEPHONE LABORATORIES
World center of communications research and development

Vigilant acquisition radar for Nike-Hercules first detects approach of distant aircraft, pinpoints its location and instantly signals to battery control.



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AUTOMATION

new equipment

Machines and plant equipment for more automatic operations
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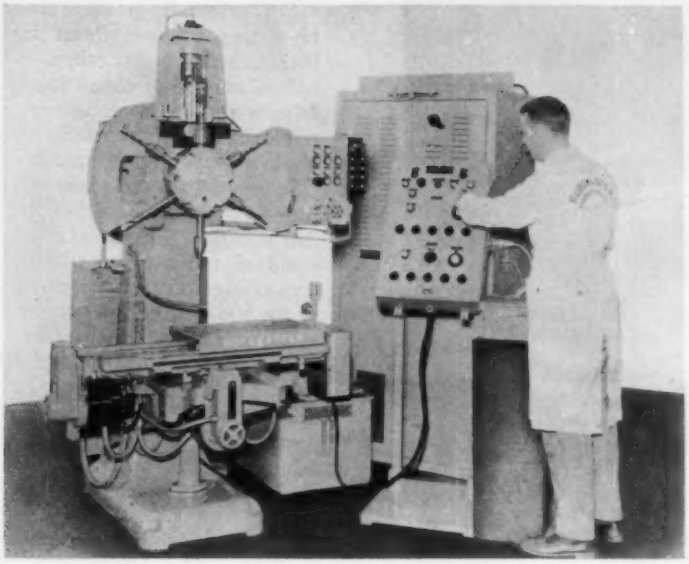

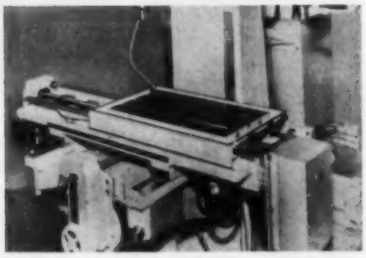

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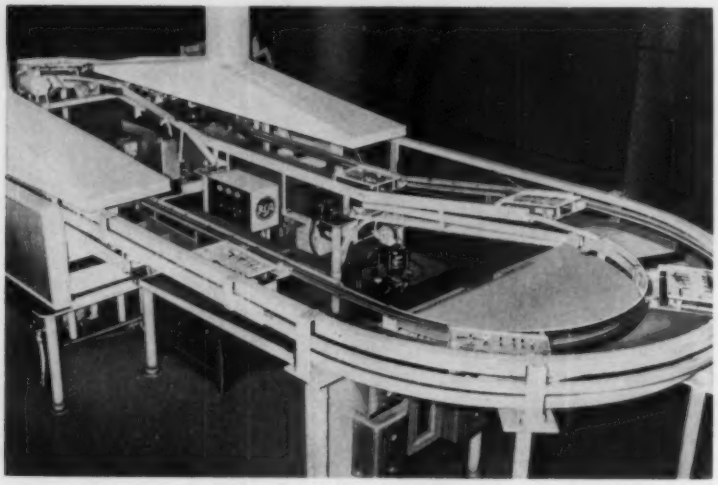
tioned, after which it will automatically advance to perform the desired operation.

Features of the Machine

Spindle speeds ranging from 20 to 3000 rpm can be obtained. Turret faces can be skipped by setting standard control pushbuttons to provide a desired sequence of operations. Accuracy of hole location is automatically controlled to ± 0.001-inch, is repeatable to ± 0.0005-inch without the need for alignment bushings. The knee supporting the table rides on double vee ways on the machine columns and is supported by a hand operated jack screw which is used for height positioning. Metal wipers shield the ways from chip damage.

Circle 401 on Page 147



Printed Circuit Board Soldering System

Item 402

Automatic system solders single-sided printed circuit board assemblies. It can handle a wide range of board sizes, eliminate solder bridging or tailing, and can solder warped panels. Up to 600 finished assemblies per hour can be obtained. System is available as a complete unit, but separate components can be provided to incorporate into existing equipment.

Heart of the system is a multi-wave cascade solderer. This unit consists of a wedge-shaped block whose bottom surface is normally one inch below the solder level of a large capacity thermostatically controlled pot. Solder is pumped through a cavity in the block so a steady stream emerges from an orifice slot and flows downward in uniform waves over four ridges on the top surface of the block.

The pallets into which the circuit boards are loaded are adjustable metal frames with wheels at each corner. Connecting links attached to a continuous chain drive pull the loaded pallets around a conveyor track. In operation, the loaded pallets first pass through a foam of flux which covers the copper circuits. Foaming is caused by controlled air jets in the liquid flux. Then the pallet moves over an electric heat-controlled radiant plate where the flux becomes hot and tacky. At the next cycle, the heated pallet advances over the soldering unit at an angle of ten degrees where the bottom of the circuit board comes in contact with four successive waves of solder. It then moves through a cleaner and the excess flux is removed from the board and pallet. The boards are then unloaded and new boards inserted in the pallets for the next cycle. **Radio Corp. of America, Industrial Automation Equipment,** Building 15-1, Camden, N. J.

Circle 402 on Page 147

Form Sorting Unit

Item 403

Semiautomatic machine is capable of sorting business forms such as bank checks, sales slips, money orders, and other coded documents. It sorts the forms alphabetically or numerically, and can handle forms of different sizes and paper stocks.

In operation, the material to be sorted is stacked in a feed hopper. An operator presses a key on a standard typewriter keyboard corresponding to the letter or number of the top form on the stack. Then a paper feeding mechanism takes the top form to a runway and directs it to the correct receiving bin for the key struck. The process is repeated until the stack of forms is exhausted. Production rate is said to be two to three times that of manual sorting.

Several models of the machine are available. The two most popular have 30 receiving bins for alphabetical and numerical sorting and 10 bins for strictly numerical sorting. Unit shown is a 10-bin numerical sorting machine. Two-digit sorting machines are available for special purposes. Any of the machines can be used to sort forms several times, using the second, third, etc. digits or letters in successive runs for refined breakdowns within major codes. **Universal Business Machines Inc.,** P. O. Box 5183, Columbia, S. C.

Circle 403 on Page 147

Air-Hydraulic Press

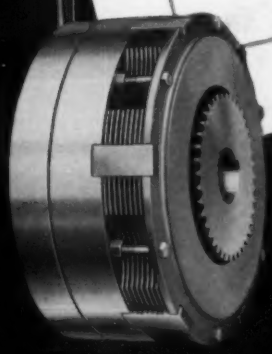
Item 404

Equipment features adjustable ram force and positive, mechanical stop control. Air-hydraulic booster unit that provides ram force is easily removed for servicing. Capable of a minimum cycle speed of 2000 spm, unit has 6-inch stroke, of which ½

Circle 680 on Page 147→

an invitation to design engineers . . .

You are Cordially Invited
to Utilize the
Many Outstanding Advantages
FAWICK MAGNETIC CLUTCHES
can Provide for Machines
Requiring
Precise Automated
POWER TRANSMISSION CONTROL
and to use
Fawick Engineering Experience
in this Field
for the Best Solution
to Your Specific Problem



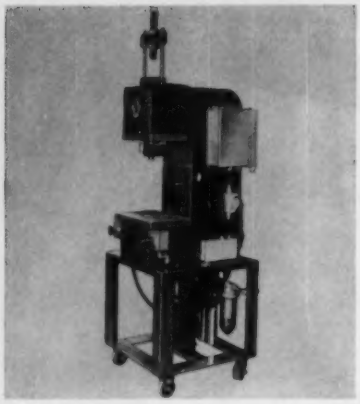
Magnetics are the clutches of the future — **and FAWICK MAGNETICS head the list for performance and dependability.** They provide fast, dependable response — with excellent torque-vs.-size ratio, consistent high performance, and instant response to limit switches, relays, punched tape, or other electric or electronic control.

Sizes range from 2¼" to 13¼" in diameter, torque ratings from 27 inch-pounds to 66,000 inch-pounds. For detailed information write for bulletin M-102 or call the Home Office, Cleveland, Ohio.

FAWICK AIRFLEX DIVISION
FAWICK CORPORATION
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK
MAGNETIC

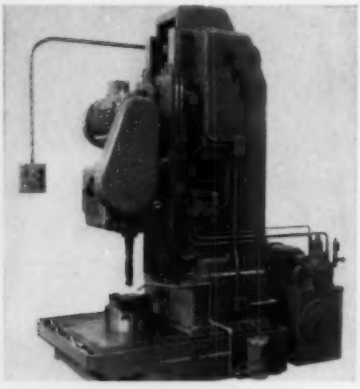
FAWICK MAGNETICS—WORLD'S FINEST ELECTRIC CLUTCHES



inch is power stroke.

Press is equipped with two safety controls wired for either timer control or manual control of cycle. Daylight opening is 12 inches and throat depth is 6½ inches. Capacities are 2½, 5, and 10 tons. **Studebaker Hydraulic Products Co.**, 1733 N. 33rd Ave., Melrose Park, Ill.

Circle 404 on Page 147



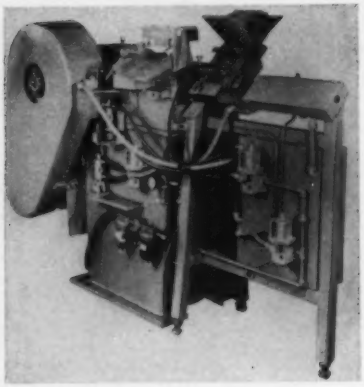
Drilling & Boring Unit

Item 405

Vertical drilling and boring machine can accommodate numerous types of heads, fixtures, indexing tables, and bases; is adaptable to a variety of machining operations. Machine is available in 15 and 30-inch strokes, with capacities up to 60 hp. The vertical slides are 26 inches wide, 48 inches long and 20½ inches across the ways.

The hydraulic feed valves are cam-actuated for positive action and the slide-mounted cams provide fast stroke setting changes. Included in the automatic cycle of operation is rapid traverse down, feed, and rapid return. A chip collection area and a built-in coolant system are contained in the base of the machine. A complete pressure lubrication system is also provided. **Machine Tool Mfg. Div., Motch & Merryweather**, 1250 E. 222nd St., Cleveland 17, Ohio.

Circle 405 on Page 147



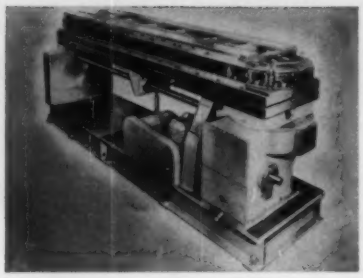
Tube Loader/Unloader

Item 406

Designed for use with company's double flaring machine, air-operated magazine feed loader and unloader can handle tubes from 3/16 to ½-inch OD and from 2¼ to 7¼ inches long. Handling rate is up to 2400 tubes per hour. Changeover from one tube length to another is fast and simple. A vibratory parts feeder can be furnished to handle tubes less than 4½ inches long automatically.

Machine is equipped with an adjustable steel hopper which holds a supply of tubes. The hopper has an agitator which helps feed the tubes into the magazine. The feeder removes the bottom tube from the magazine and feeds it into the open flaring die. In operation, the flaring machine clutch is energized and the tube is flared. During a second flaring stroke, the feeder returns to its *Start* position. At the end of the second stroke, the unloader arm reaches into the open die and removes the flared tube by means of a permanent magnet. The tube is removed from the magnet by a gate through which only the magnet passes. The removal of the tube trips a switch which starts the next automatic cycle. **Automation Associates Inc.**, 1444 E. Eleven Mile Rd., Madison Hts., Mich.

Circle 406 on Page 147

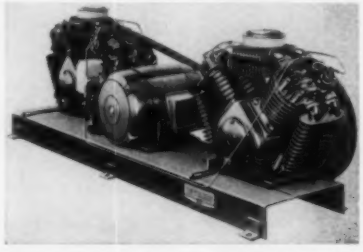


Indexing Chassis

Item 407

Suitable for automatic assembly or production work, conveyor type cam-operated indexing chassis is available with either 27, 35, 43, or 51 work carriers. The carriers on Model ST-A18 are an integral part with the precision conveyor chain links which position the work accurately at each station. The cam shafts which provide the tool actuation are two inches in diameter. Indexing takes place during 120 degrees of rotation of the cam shaft. The remaining 240 degrees is used for dwell or work time. **Standard Tool & Mfg. Co.**, 237 Laurel Ave., Kearny, N. J.

Circle 407 on Page 147



Air Compressor

Item 408

Unit features double compressors, can displace from 96.4 to 129 cu ft of air per minute. It can be used for spray painting and for operating air tools. Compressor is equipped with pressure switch and magnetically controlled unloaders. For automatic *Start-Stop* operation or constant speed unloading, a magnetic starter with selector switch is available. Vertical air receivers are furnished for remote installation. Compressor uses 20 or 25 hp, motor delivers air at 125 and 175 psi. **DeVilbiss Co.**, Toledo 1, Ohio.

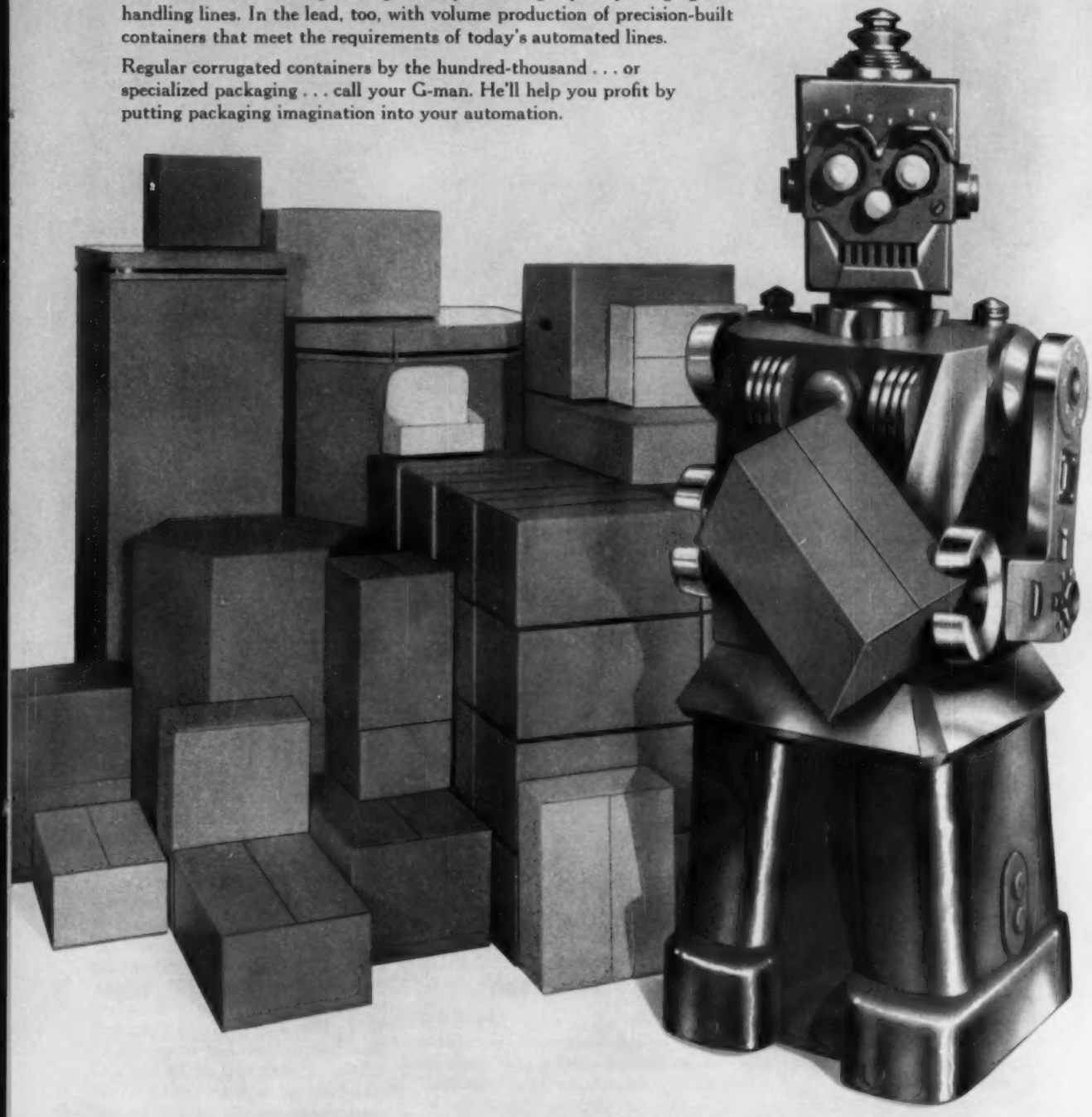
Circle 408 on Page 147

Circle 681 on Page 147→

GAYLORD PUTS IMAGINATION INTO YOUR AUTOMATION

Not ready for robots? Fast-moving progress in automation can out-date your packaging operations in just a few years. That's why you'll find Gaylord in the lead with new engineering techniques for high-speed packaging and handling lines. In the lead, too, with volume production of precision-built containers that meet the requirements of today's automated lines.

Regular corrugated containers by the hundred-thousand . . . or specialized packaging . . . call your G-man. He'll help you profit by putting packaging imagination into your automation.

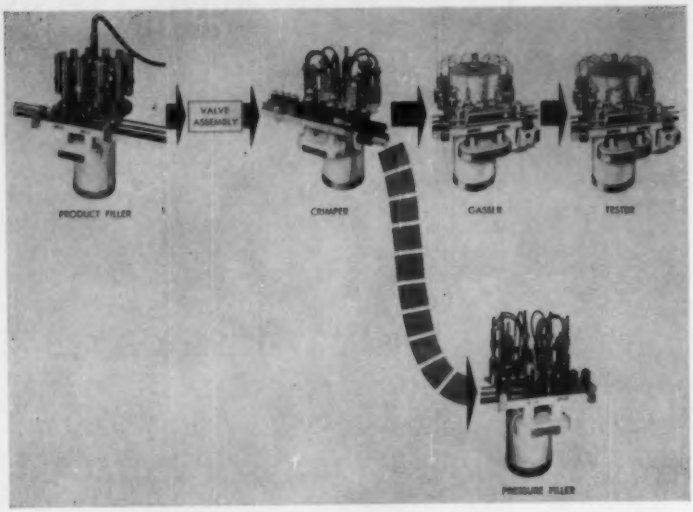


GAYLORD
CONTAINER CORPORATION

Gaylord Boxes

HEADQUARTERS, ST. LOUIS
PLANTS COAST TO COAST

DIVISION OF **Crown Zellerbach Corporation**



Aerosol Container Filling Line

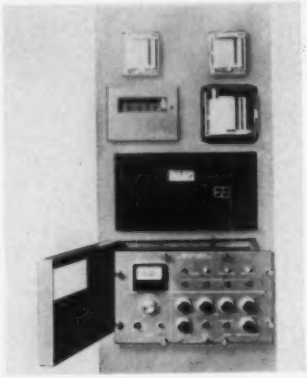
Item 409

Line of continuous rotary machines is capable of performing a series of specific operations in the product filling, valve crimping, and pressurizing of aerosol containers. A star wheel arrangement at the front of each of the machines removes containers one-at-a-time from a conveyor line and deposits them in stations on the peripheries of rotary machine drums. Each operation is performed while the containers travel with the drum. After an operation is completed the containers are redeposited on the conveyor line.

The type of propellant to be used determines the type of equipment needed in a given aerosol filling line. If liquid hydrocarbon propellants are to be used, the space above the product container must often be evacuated. The crimping machines provide a vacuum propellant-purging function to give maximum concentration of propellant in the space above the product. When nitrogen or carbon dioxide gas mixes are used as propellants, individual gasser and tester functions follow the crimping operation. For propellants that have to be mixed with the product, a shaking operation is performed at each station on the gasser.

The machines used in a typical line include: Liquid filling machines available in 4, 8, 12, and 16 station types; crimpers in the same types; gassers for pressure filling of nitrogen, nitrous oxide, and carbon dioxide available in 4, 8, 12, and 16 station models (machines which shake the container are made in 9 and 15 station types); testers available in 12 and 16 station types. Pressure fillers for fluorinated and other hydrocarbon propellants are available in 4, 8, 12, 16, and 24 station types. Fill capacities from zero to 45, 100, 300, and 500 cc can be had. **Arthur Colton Co.**, 3400 E. Lafayette, Detroit 7, Mich.

Circle 409 on Page 147



Gas Chromatograph

Item 410

Recording instrument is capable of controlling process operations by cascade control through chromatography. In operation, analysis by the chromatograph results in an electrical signal output for each component of interest. The signal is transformed by a transducer to a pneumatic signal proportional to the quantity of component. When the signal into the transducer reaches a maximum, the transducer holds at its maximum. Simultaneously, a timing device programs the opening and closing of valves to pneumatic receiver and memory units. This timer also programs the restoration of the transducer system to normal operation from its held position after the peak value is properly stored in the memory.

The pneumatic signal for each component is transmitted from the pneumatic memory system to a recorder, resulting in a quantitative trace of the signal peak. The memory unit maintains pressure so the signal to the recorder continues when the electrical signal to the transducer returns to zero, thus providing a continuous trend trace of component concentration. **Scientific & Process Instruments Div., Beckman Inc.**, 2500 Fullerton Rd., Fullerton, Calif.

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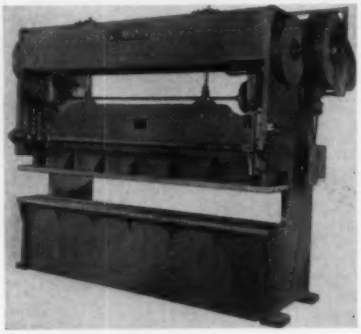


Gang Punching Machine

Item 411

Equipment, having a capacity of 60 tons, provides 126 inch lateral opening between housings. Features of the unit include pushbutton clutch control, automatic lubricating system, and air counterbalance of the ram. The ram is of single plate construction, and the bed is of two plate construction with two slug chute openings in the rear. Stroke of the machine is 4 inches. There is a 4-inch ram adjustment. Shut height from bed to ram is 14 inches. Dimensions of the bed and ram front to back and right to left respectively are 20 by 132 inches. Operating speed is 45 strokes per minute. **Verson Allsteel Press Co.**, 9300 S. Kenwood Ave., Chicago 19, Ill.

Circle 411 on Page 147

interchangeable with all standard JIC cylinders

With the introduction of the ALL NEW T-J Squair Head, Tomkins-Johnson now offers industry the most complete design range of air and hydraulic cylinders. Presently available in bore diameters from 1½ to 8 inches, the T-J Squair Head is an interchangeable cylinder which produces maximum force and efficiency, with minimum pressures . . . and is also adaptable to the use of low pressure oil as the working medium. Write to The Tomkins-Johnson Co., Jackson, Michigan, for Bulletin #SQ 10-58 and complete details.

CHECK THESE 10 POINTS OF T-J SUPERIORITY

1 One Piece Piston

2 Hard Chrome Cylinder Bore and Piston Rods

3 High Tensile Steel Tie-Rods

4 Cushion Adjusting Screw, Externally Adjustable

5 New Super-Cushion for air, or Self-Aligning Master Seal for Oil (T-J Patents)

6 Solid Steel Heads and Mounting Plates Standard all Models

7 Port Design Allows Minimum Pressure Drop on Inlet or Outlet

8 Chevron Type, Self-Adjusting Rod Packing

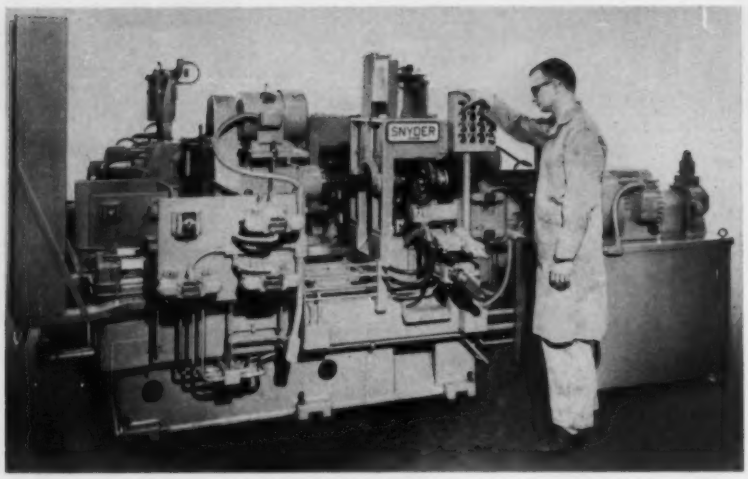
9 Piloted Packing Gland–Absolute Alignment

10 Piston Rod, Extra Strong–Polished and Chrome Plated for Efficiency and Protection

T-J TOMKINS-JOHNSON

VALVES . . . AIR AND HYDRAULIC CYLINDERS . . . CUTTERS . . . CLINCHERS

Circle 682 on Page 147



Roller Machining Unit

Item 412

Unit is a combination of a single-end boring machine and a straight-line indexing machine. It is capable of boring, drilling, chamfering, and tapping four different track rollers for crawler-type tractors. Two of the parts require the same machining. Interchangeable heads are provided for machining the other two parts.

In operation, parts are placed in a gravity-type loader where they roll into machining position for the boring operation. Finish-bored parts are automatically transferred to a fixture in the indexing section by a hydraulic cylinder-actuated transfer mechanism. Then the fixture is automatically indexed in sequence to three stations where six holes are drilled, chamfered, and tapped. At the end of the tapping operation, a finished part rolls out of the fixture and the fixture is returned to the *Start* position where it receives another finish-bored part from the boring machine. Production rate is 39 pieces per hour. **Snyder Tool & Engineering Co.**, 3400 E. Lafayette, Detroit 7, Mich.

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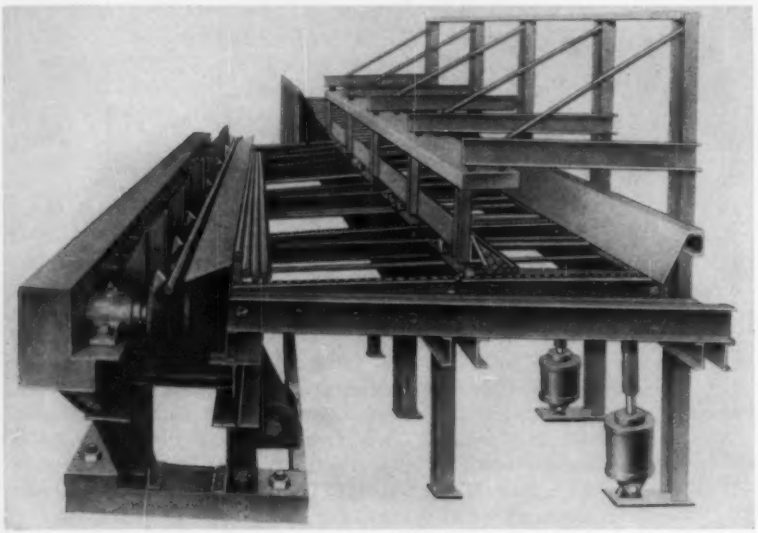

Automatic Bar and Tube Feeding System

Item 413

Unit performs four handling functions in one continuous operation: It receives bundles of bar or tube stock at the loading end; transfers the bundles to a bundle unscrambler; unscrambles the bundles and transfers the bars; and feeds the bars or tubes singly as needed. At the receiving end is a hopper type live roll conveyor section. The rolls are supported on helical springs that absorb the shock resulting from the loading of 12,000 lb bundles. When a bundle is loaded, it is automatically conveyed lengthwise to an intermediate section of the machine. From the intermediate section, the bundles are automatically conveyed to the bundle unscrambler and transfer section. As the forward end of the bundle arrives at the transfer section, the bundle is automatically stopped. After the bands are removed from the bundle, a transfer device conveys the rods crosswise under a gate to the discharge end of this section. The gate is set to limit the flow to a single layer of bars. The bars can then be conveyed into feed rolls, to the length gage of a shear, into a press, or into a furnace. Machine can be synchronized with an automatic conveying system and is also adaptable to electronic control. **Spurgeon Co.**, 23501 Hoover Rd., Warren, Mich.

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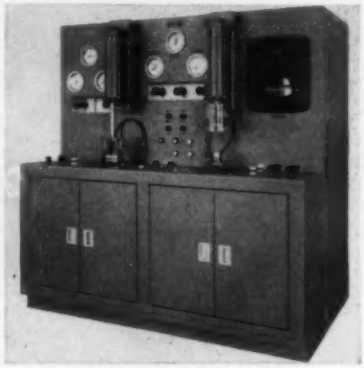
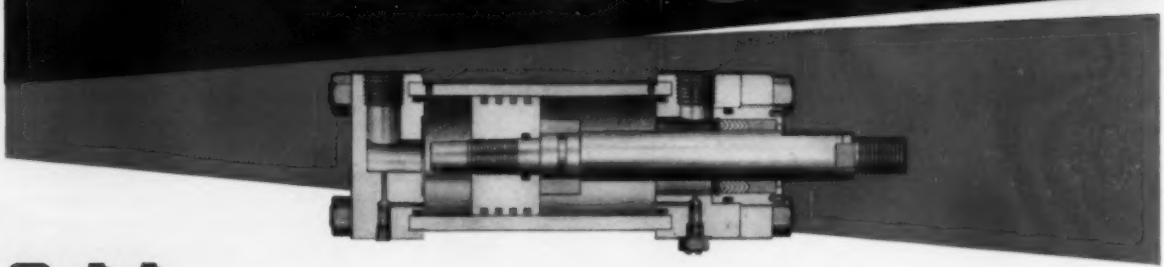


Pump Leak Tester

Item 414

Unit tests automotive transmission pump components, will reject any part which shows a leak equivalent to one drop of oil in a twenty-four hour period when under pressure. In operation, at the start of the test cycle, a part is placed in one of a pair of jigs and pneumatically clamped. A short blast of high pressure air is applied to test the pump for blow-out failure. If all of six plugs in

sealed right!



O-M Heavy-Duty Series TH Hydraulic (Oil) Cylinders

IF you are experiencing difficulty with leakage through the seals and packings of the cylinders you have been using, the O-M "TH" Series Heavy Duty Hydraulic cylinders may be the answer to your problem. Since their introduction in 1955 these cylinders have established an enviable reputation for efficient and trouble-free service.

The O-M Series TH Cylinders are Designed Right to Seal Right. Prior to the design of these cylinders, many tests were made and field experiences were surveyed to find the most efficient way to eliminate the old "leakage problem".

Homogeneous "O" rings, with their elastic characteristics, cannot be excelled as static seals when backed-up with plasticized leather non-extrusion rings and installed in a properly designed cavity.

Ring-type piston packings are excellent for long-life and trouble-free performance when a small amount of piston by-pass is permissible. When by-pass is not allowable, "Vee-type" packings similar to those used as standard in the rod gland provide optimum sealing. The "Vee-type" packing is self adjusting and provides multiple lip sealing with excellent pressure sensitivity and long life.

The homogeneous "lip-type" rod wiper or the metallic scraper (your choice) is located well forward so as to prevent dirt from accumulating and scoring the piston rod and damaging the bearing and packing.

O-M Series TH Cylinders are "Designed Right" and "Sealed Right". Available in 1½" to 8" bores with complete selection of mountings. Mail coupon TODAY for Bulletin No. 105 showing description drawings of cylinders mountings and capacity chart.

ORTMAN-MILLER MACHINE COMPANY
25 143rd Street, Hammond, Indiana

☐ Have representative call
☐ Send Bulletin 105

Name_____ Position_____
Company_____
Address_____
City_____ Zone_____ State_____

the unit remain in place after this phase of the test, a regulated air supply at low pressure (20 psi) is brought in. A solenoid valve then closes off the supply, trapping the air in the oil passages of the part. A sensitive differential pressure cell which reads out to a pressure switch evaluates the leakage by measuring the pressure drop of the trapped air. If the leakage is below the limit set on the controller, a green *Accept* lamp is lighted and the part is automatically unclamped. If leakage is above the limit, the part remains clamped and a red *Reject* light comes on. The operator then presses a button which immerses the part in an antirust solution to identify the defective part. **Cen-Tec Corp.**, 38903 Schoolcraft Rd., Livonia, Mich.

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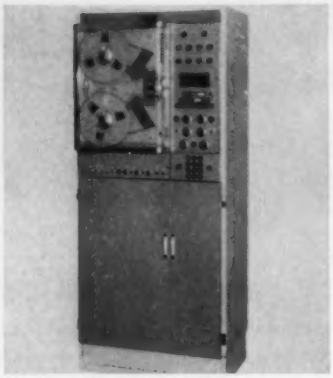

Magnetic Tape Plotter

Item 415

Designed for use with company plotting boards, magnetic tape data reduction unit can present data in points, distinctive symbols, or continuous lines. Statistical charts of all types and many forms of mechanical drawings are quickly and accurately drawn. Unit accepts tape codes written on digital computing equipment. For applications other than plotting, analog voltages are available. Provision is made for the selection of tape data, numerical co-ordinate readout, and tape location indicators. Features of the machine include automatic symbol selection and sequencing. **Electronic Associates Inc.**, Long Branch, N. J.

Circle 415 on Page 147

Checkweigher

Item 416

Automatic checkweighing machine features an even-balance lever system which is unaffected by normal machinery vibration. Weight indication is by an optical light projection system which gives a visual display. Electronic control system consists of direct-reading crystal photocells mounted alongside the scale dial. The photocell control provides direct correlation between the dial reading and a control set point. The projected light on the dial moves in direct relation to the scale lever movement. The crystal photocells are said to be unaffected by heat, moisture, or normal environmental conditions.

Model 1206 can supply a binary coded output signal for automatic recording, classifying, and feedback control. It is capable of speeds up to 120 weighings per minute with accuracies of 0.2 per cent. **Exact Weight Scale Co.**, 538 E. Town St., Columbus 15, Ohio.

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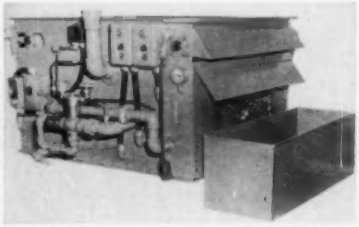

Coolant Filter

Item 417

Device is a combination filter and dragout conveyor which can handle water, water soluble, and oil coolants. The filtering medium consists of a tubular screen rotating at the same speed as that of the conveyor system. A feature of the filter is an intermittent clean coolant automatic back-wash which is operated by electric controls. One pump and motor furnish clean coolant to the machine or tool, at the same time furnishing clean coolant for back-washing. Sizes of particles filtered depend on screen size and timing adjustment of the back-wash. Coolant capacities range from ten gpm up. **Lundholm Mfg. Co.**, 1121 Charles St., Rockford, Ill.

Circle 417 on Page 147

Induction Heating Unit

Item 418

Generator has two selectable frequency ranges for flexibility in heating operations. High frequency range of 2 to 5 mcps is suitable for heating thin parts and semiconductor materials, and for producing superficial heating of other materials. Low frequency range of 250 to 600 kcps is used for general heating applications. The high frequency tank circuit components are located in the lower cabinet and the standard low frequency tank circuit components are in the smaller cabinet on top. Both circuits use the same oscillator tube and dc power supply. Each tank circuit has a separate grid control for proper adjustment for grid drive requirements. Generator is rated at 10 kw output power. **Lepel High Frequency Laboratories Inc.**, Woodside, N. Y.

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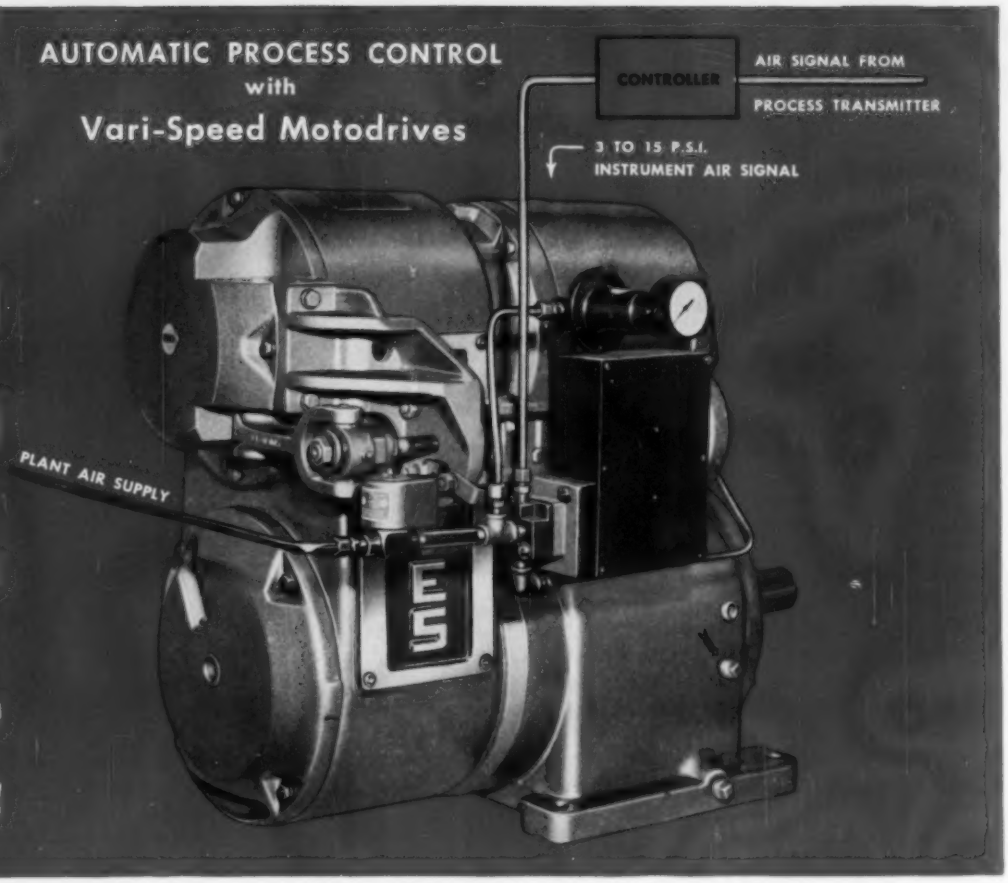
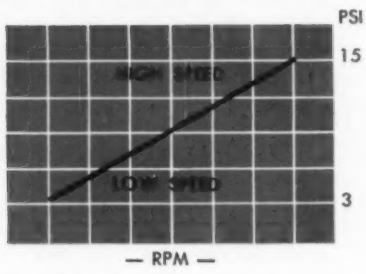
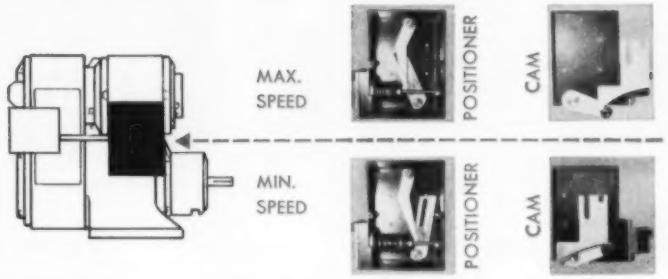
REEVES AIRtrol

AUTOMATIC PROCESS CONTROL
with
Vari-Speed Motodrives



Sensitive Speed Reaction to Controller Signals ... Straight Line Variable Speed Output





• REEVES AIRtrol, in an open or closed loop system, automatically and continuously corrects operating speeds to compensate for variations in materials or energy (i.e. temperature, liquid level, density or flow).

As the final control element, the pneumatically-controlled Motodrive assures sensitive and stable control throughout the speed range.

Linear speed output is a result of the exclusive cam design. The AIRtrol responds to a 3 to 15 p.s.i. pneumatic signal, and is adaptable to all standard process instrumentation.

The AIRtrol is available on all REEVES Motodrives . . . hundreds of assemblies from ¼ through 40 hp., 2:1 through 10:1 speed range, and 1.7 through 4660 rpm.

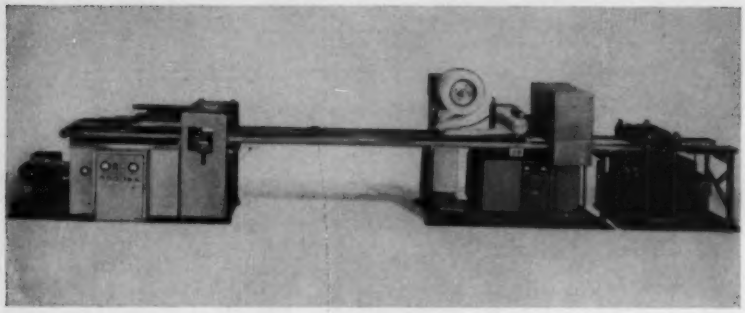
For examples of AIRtrol in process control systems, write Dept. AN 39 for AIRtrol Instrumentation Data Sheets.

VARI-SPEED MOTODRIVE
VARI-SPEED MOTOR PULLEY
VARIABLE SPEED TRANSMISSION

REEVES PULLEY COMPANY
Division of RELIANCE ELECTRIC AND ENGINEERING CO.
COLUMBUS, INDIANA
In Canada: Reeves Drives • Toronto • Montreal

R MASTER REEVES

Circle 684 on Page 147



Plastic Bubble Packaging Machine

Item 419

Automatic feeding, forming, loading, printing, and diecutting operations are performed with plastic bubble packaging unit. Machine includes a product loading station, roll plastic feed, vacuum bubble former, roll feed for second plastic film or coated backing board, printer or coding device, diecutter, and dielectric sealing press. Sealing operation is accomplished with radio frequency heating. With this method, the heat is focused at the point of sealing and is said to eliminate warped card backing and prevent damage to products. A centralized control panel provides control of all operations, while individual controls located at each section of the machine provide local control of operations. Safety features include interlocks and overload controls. A printing or coding device automatically marks all packages with a preset identification. **Erdco Engineering Corp.**, Addison, Ill.

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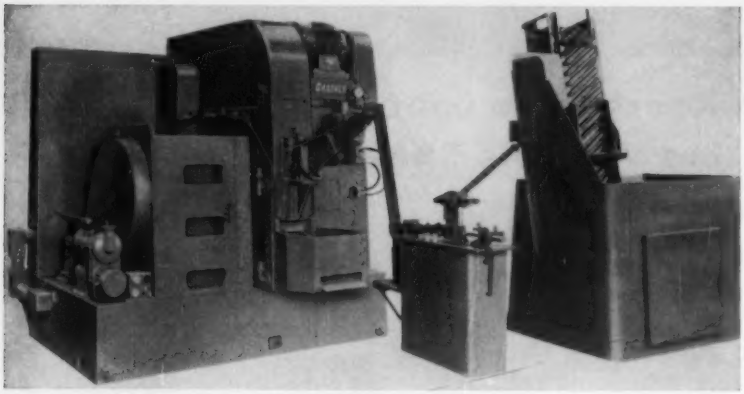

Disc Grinder Line

Item 420

Horizontal dual spindle disc grinder is capable of rough and semifinish grinding the closed ends of valve lifter bodies at the rate of 3500 per hour. Equipment on Model 723 includes: Hopper to automatically load the rotary carrier, transfer-orienting attachment, and two electric gaging units with automatic feedback.

In operation, the workpieces are picked up by the elevator of the hopper conveyor and are carried by a chute to the transfer attachment where they are oriented so the closed ends of the valve lifter bodies will be ground. Then they are lifted to an inclined feed trough where they roll down and are positioned laterally by side guides before entering a rotary carrier in the grinder. A chain hold-down mechanism secures them while grinding. After the part is rough ground on a 30-inch disc, it passes a gaging unit. If the workpiece is approaching its high limit of tolerance, the gaging unit effects head feed advance of the rough grind disc. Then the workpiece is moved through a semifinish grind zone. After completion of this grind, it passes another gaging unit and is released down an unloading chute. A similar corrective process is effected to maintain semifinish grinding tolerance. **Gardner Machine Co.**, Beloit, Wis.

Circle 420 on Page 147

Automatic Diode Tester

Item 421

Instrument is suitable for production testing, engineering analysis, quality control, or incoming inspection of in-line lead, packaged diodes and rectifiers. A test rate of up to 3600 diodes per hour can be obtained. Model T-501 will automatically sort diodes into one of eleven categories according to peak inverse voltage ratings and forward voltage drop. If the diode being tested is determined to be either open or shorted during the orientation portion of the test, all further tests are eliminated and that diode falls into a reject bin.

Unit can be adapted to test many types of products with completely different characteristics. By removing one test chassis and inserting another, the type of test, test parameters, and test sequence can be changed. Tester is rated for 110-125v ac, 50-60 cps, 5 amps. **Atlantis Engineering Corp.**, 1807 Stratford Dr., Garland, Tex.

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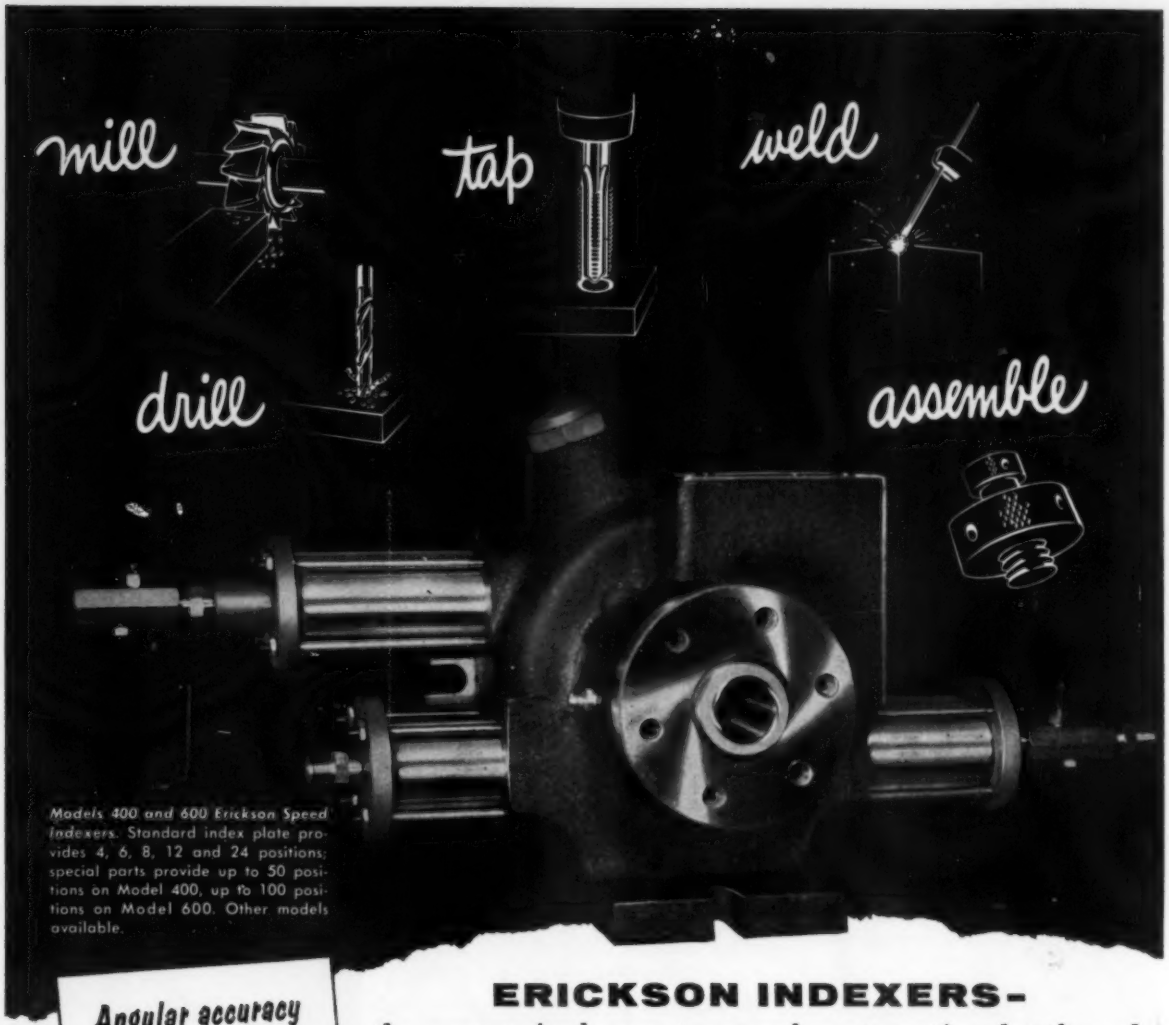
Press Extractor

Item 422

Portable unit is capable of loading, transferring, or removing piece parts, scrap, and other materials to and from production machines such



Models 400 and 600 Erickson Speed Indexers. Standard index plate provides 4, 6, 8, 12 and 24 positions; special parts provide up to 50 positions on Model 400, up to 100 positions on Model 600. Other models available.

Angular accuracy within 2 minutes... repetitive accuracy in low "tenths" of a thousandth

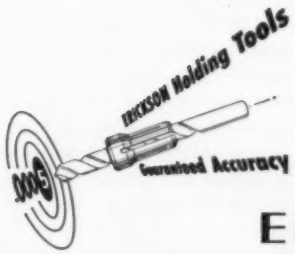
ERICKSON INDEXERS–

the economical way to smash automation bottlenecks

Even the most elaborate automatic production line can bog down *expensively* without rapid and accurate automatic parts positioning.

That's where Erickson Indexers really pay off. For you can interlock them into your production set-up with micro switches and solenoid valves. The hardened and ground lock pin operates in conjunction with the actuating mechanism to assure *positive positioning and angular accuracy within 2 minutes of a degree.* (Repetitive accuracy is no indication of angular accuracy. Erickson holds repetitive accuracy in low "tenths" of a thousandth.) And Erickson Indexers can maintain this great accuracy because their adjustable, self-contained shock control unit delivers a cushioned rotary load to the mechanism, thereby reducing wear.

Speed to keep lines moving . . . acouracy to reduce rejects . . . long life to cut maintenance and capital investment – all add up to Erickson Indexers, the *economical* way to smash automation bottlenecks.



Write for Erickson Catalog K today! You'll find many interesting applications for all Erickson holding tools. Take advantage of our free engineering service. An Erickson field engineer will gladly work with you for production economy.

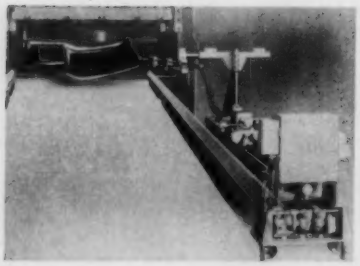
ERICKSON TOOL COMPANY

34454-2 Solon Road • Solon, Ohio

COLLET CHUCKS • FLOATING HOLDERS • TAP CHUCKS • TAP HOLDERS • AIR-OPERATED CHUCKS
EXPANDING MANDRELS • SPECIAL HOLDING FIXTURES

AA-2107

Circle 685 on Page 147



as punch presses, forging presses, and die casting machines. When equipped with a shovel unloader instead of standard jaws it can be used to strip parts from the top half of a die using a positive knock-out at the top of the press stroke. Unit can be easily timed to production cycles, has an interlock feature which is said to reduce loading and unloading time. **Die & Automation Inc.**, 5353 Dixie Highway, Hamilton, Ohio.

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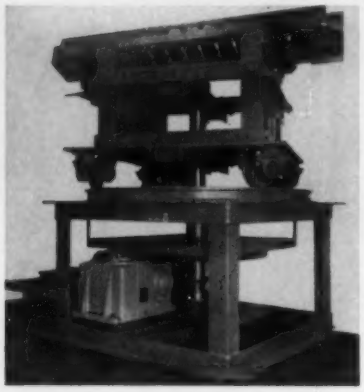

Conveyor Turntable

Item 423

Unit can handle steel coils weighing up to 30,000 lb, will rotate them 90 degrees for right-angle transfer to connecting conveyor lines. It can also rotate the coils 360 degrees in positioning or orienting coil ends for proper feeding into processing machinery. The coils ride on a section of heavy duty troughed roller conveyor which forms the bed of the turntable. This section is mounted at a suitable pitch and the low end is equipped with a counterweighted plate stop which automatically releases with the rotation of the turntable. The rotating carriage is supported on four flanged wheels with shafts mounted in antifriction pillow blocks. The wheels run on a circular track. Unit is power operated from an electric motor and speed reducer through a gear and pinion drive. **Logan Co.**, 200 Cabel St., Louisville 6, Ky.

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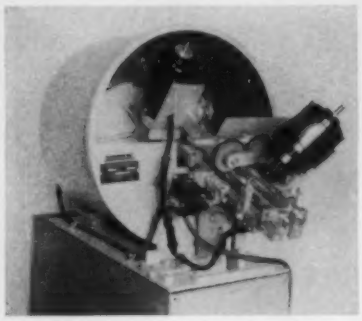

Parts Feeder

Item 424

Device combines a cast drum with built-in universal pickup pockets and live feed rollers. The live rollers, which are self-feeding and constantly in motion, prevent items handled such as nails, screws, rivets, setscrews, tablets, and capsules from jamming in the discharge track. Production rate for small screws is 1000 parts per minute. Changeover for Model R is simple and quick. In many cases, a range of sizes can be run without changeover. For counting purposes, the machine can be provided with a mechanical release finger to release a predetermined number of parts at a time. Unit can be used to orient and feed various items to assembly or other machines. **U. S. Engineering Co.**, 40-24 22nd St., Long Island City, N. Y.

Circle 424 on Page 147

Chemical Analyzer

Item 425

Instrument provides a continuous automatic chemical analysis, detecting trace materials in parts per billion with an accuracy of one per cent. It is suitable for materials such as cyanides, sulfur dioxide, silica, phosphates, iron, chlorides, copper, sulfates, ammonia, sugars, and aluminum. The instrument automatically performs each step in the operation (measuring, mixing, purifying, processing, comparing, and recording) on a continuous flow basis. The analyzer can be hooked up to a process or waste stream, which may be liquid or gas. The concentration level of any material or a number of materials can be continuously monitored and permanently recorded. Also, the control loop can be closed to automatically monitor steady-state control devices and thus regulate the process through on-stream continuous measurement. **Technicon Controls Inc.**, Chauncey, N. Y.

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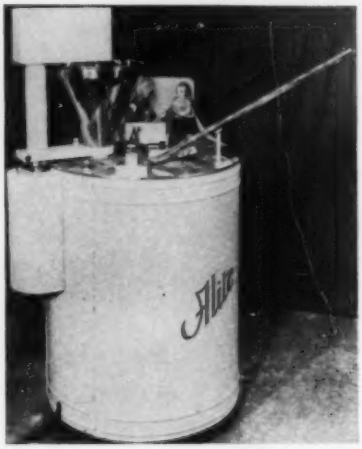


Powder Compressor

Item 426

Hydraulic equipment is suitable for compacting and tableting powders of all types. The pressure, selected by a single control, can be from 40 to 1000 psi. The machine will handle containers which range in size from one to four inches in diameter, with depth of fill adjustable to close tolerances, and output speeds up to 1200 containers per hour. Optional equipment for removing surplus powder is a vacuum type dust extractor. The powder is collected into bags which permit powder reclamation. **Arenco Machine Co.**, 25 W. 43rd St., New York, N. Y.

Circle 426 on Page 147

MICRO SWITCH Precision Switches

Sealed "ML" switches with roller lever actuators, roller plunger actuator, low-force rod actuator, straight plunger actuator. Operating force ranges from 5 oz. for the rod actuator to 6 lbs. for the straight and roller plunger actuators.

"ML" Series sealed limit switches for heavy-duty industrial applications

Long-life precision switching elements in sturdy sealed aluminum housings characterize the "ML" switch family. "ML" switches have proved beyond doubt their ability to stand up under extreme mechanical punishment in the worst of environments . . . are widely used on machinery and other industrial equipment.

Sealed "ML" limit switches meet NEMA standards for non-ventilated enclosures of type IV-1C1.12 watertight and type VI-1C1-1.15 submersible.

Additional advantages of "ML" switches include:

- Adequate wiring space
- Switching elements have #8 screw terminals
- Additional actuators available
- Sealed covers secured with captive screws

Contact arrangements (and abbreviated electrical ratings to show range) include:

Two-circuit double-break—up to 600 vac.
Single-pole double-throw—up to 600 vac.
Double-pole double-throw—10 amps., 125 or 250 vac.

These switches are available through the Authorized Distributor near you. Help in switch selection is available from MICRO SWITCH branch offices. Consult the Yellow Pages. For complete description of "ML" and other heavy-duty switches, send for Catalog 84.

MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell

In Canada: Honeywell Controls Limited, Toronto 17, Ontario

Honeywell
MICRO SWITCH PRECISION SWITCHES

Circle 686 on Page 147

NATIONAL ELECTRIC

solves tough production problem of welding air-suspension brackets for 1958 cars

The new air suspension systems introduced on some 1958 cars, create not only a super-smooth ride for passengers . . . but many production problems for manufacturers. To help lick one of these problems . . . National Electric designed and built two new multi-station arc welders that perform 2 important operations on the structural members of the new systems.

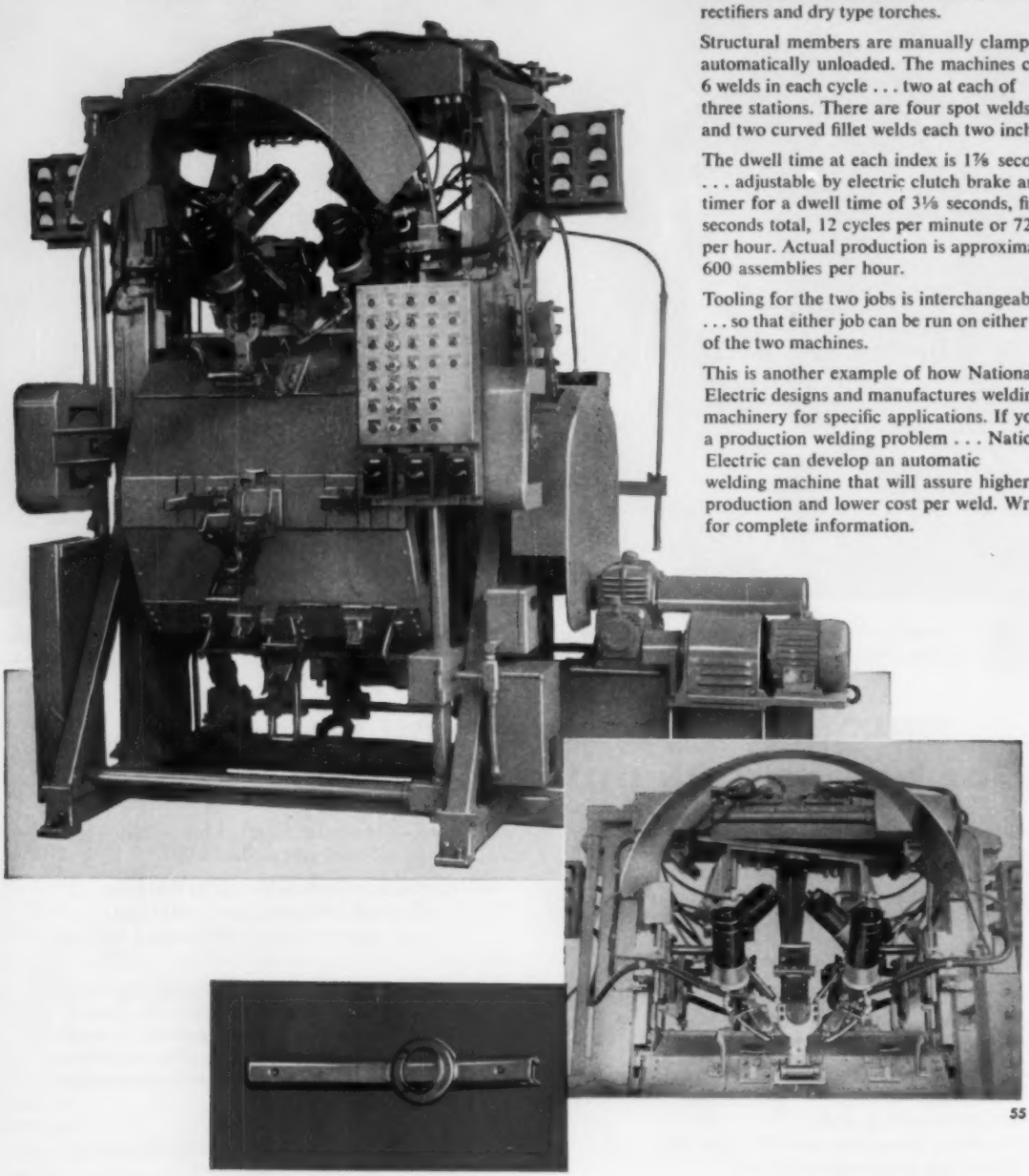
These 6-head, CO_2 arc welders incorporate a drum feed, 8-station Geneva Index, with 800 amp. rectifiers and dry type torches.

Structural members are manually clamped and automatically unloaded. The machines complete 6 welds in each cycle . . . two at each of three stations. There are four spot welds . . . and two curved fillet welds each two inches long.

The dwell time at each index is 1⅞ seconds . . . adjustable by electric clutch brake and timer for a dwell time of 3⅛ seconds, five seconds total, 12 cycles per minute or 720 cycles per hour. Actual production is approximately 600 assemblies per hour.

Tooling for the two jobs is interchangeable . . . so that either job can be run on either of the two machines.

This is another example of how National Electric designs and manufactures welding machinery for specific applications. If you have a production welding problem . . . National Electric can develop an automatic welding machine that will assure higher production and lower cost per weld. Write for complete information.



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NATIONAL ELECTRIC WELDING MACHINES CO.

1870 N. TRUMBULL STREET • BAY CITY, MICHIGAN

25 YEARS EXPERIENCE DESIGNING AND BUILDING: SPECIAL & STANDARD • AIR • HYDRAULIC • MOTOR DRIVEN • SPOT • PROJECTION • SEAM • BUTT • FLASH • RESISTANCE WELDERS • PRODUCTION FIXTURES FOR ALL TYPES OF AUTOMATIC ARC WELDING.

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems.

For detailed information and literature, use card page 147.

Helical-geared Speed Reducers

Reducer unit for shaft-mounting is equipped with an adjustable reaction rod which prevents rotation of the unit and provides adjustment of the input drive.

LINE of helical-geared speed reducers features a basic unit with either single or double reduction helical gearing, which can be mounted directly on the driven shaft or mounted in horizontal or vertical bases. All components in the line are standardized for adaptation to different drives. The basic unit, designed by **Boston Gear Works**, 14 Hayward St., Quincy 71, Mass., is available in three types: Reductor for V-belt, sprocket or gear drive to input shaft; Ratiomotor provides direct motor drive to input shaft; and Flanged Reductor which is the Ratiomotor without the motor. Four sizes of the basic unit provide output speeds of 10 to 431 rpm and capacities of 1/6 to 15 hp. The gear shafts in the basic unit are mounted in ball bearings, and double-lipped oil seals for all shaft openings protect against leakage.

A positive backstop can be inserted in the unit by removing a cover on the back of the housing. The backstop operates instantly to prevent reversal of rotation (this accessory is especially suitable for conveyor drives). When the speed reducer is to be shaft mounted, it can be equipped with an adjustable reaction rod which prevents rotation of the unit and provides for adjustment of the input drive. When the reducer is mounted in a horizontal base, it can be set at any of four positions. Four positions are also possible in the vertical base-mounted unit, and the input shaft can be through the base or opposite the base. A groove is provided in the OD of the hollow output shaft to permit use of a wheel-puller in removing the reducer from the shaft.

Circle 427 on Page 147

Horizontal base-mounted unit with motor. The gear unit can be rotated and reset in the base at any of four positions to suit drive conditions.

Electronic Recorder

Item 428

Instrument features continuous integration, is capable of measuring, recording, and continuously totalizing any linear variable with respect to time. It can be used for gas chromotography analysis, for continuous weighing systems, and to record electric power line network consumption, and electric current in aluminum pot lines.

The recorder reads out the integration quantitatively on a six-digit electric counter at a rate of up to 1000 counts per minute, or records the qualitative or analog equivalent on a chart graduated in units and tens by means of a dual pipping pen at a maximum rate of 500 strokes per minute. For special applications, the readout can be adapted to digital or data-handling systems by substituting a contact-making counter. Accuracy of the integrator is ±0.5 per cent. Chart record speeds are 30, 60, 90, and 120 inches per hour. **Brown Instruments Div., Minneapolis-Honeywell Regulator Co.**, Wayne & Windrim Aves., Philadelphia 44, Pa.

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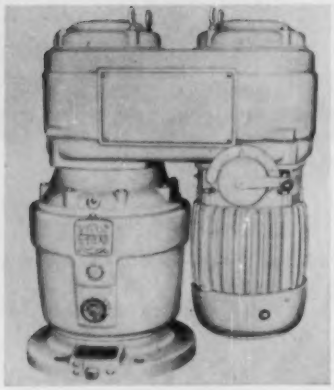
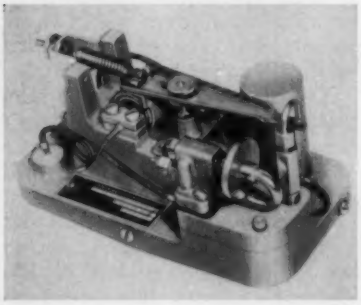


Variable Speed Drive

Item 429

Suitable for agitators and mixer operations, variable speed drive consists of a single integrated unit, ac motor, mechanical type variable speed transmission, and double reduction gearing. The different types of speed control available are: Varitrol automatic control, a handwheel on the unit, remote mechanical, or remote electrical. With the Varitrol automatic control, the speed of the drive can be automatically adjusted to meet any change in viscosity of the material being mixed. Unit can be furnished in a horsepower range from 3 to 30, with speed variations ranging from 2:1 to 7:1. Rpm range is from 30 to 380. **U. S. Electrical Motors Inc.**, Box 2058 Terminal Annex, Los Angeles 54, Calif.

Circle 429 on Page 147

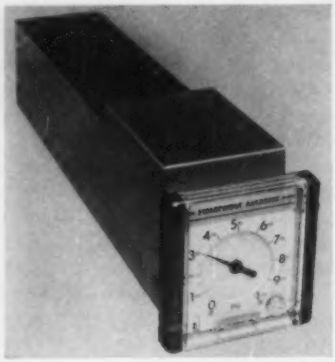


Temperature Transmitter

Item 430

Instrument is designed to convert temperature, measured by a filled thermal system, into a proportional 3-15 psi output air pressure. The nonindicating instrument then transmits this pressure to a receiving recorder, indicator, or controller. Actuating element of the transmitter is a bourdon spring of a mercury filled system. The bourdon spring moves the beam to reposition the baffle with respect to the nozzle. The nozzle back pressure is then amplified in a reverse-acting relay and becomes the instrument output. This pressure also goes to the feedback bellows and acts as the restoring force tending to bring the nozzle and baffle back to their original positions. Transmitter can be mounted on flat surfaces, pipe lines, well wrench heads, on pipe hangers, or on separable bushings. Model 202T is available in various models to cover a range of temperatures from −30 to 1200 F. **Taylor Instrument Companies**, 95 Ames St., Rochester 1, N. Y.

Circle 430 on Page 147

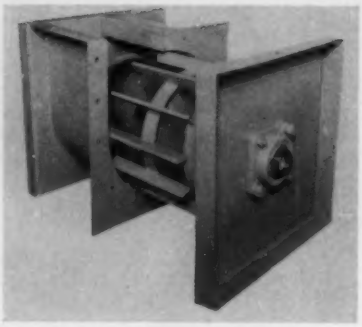


Indicating Digitizer

Item 431

Instrument is capable of translating an analog signal from a company transmitter or converter into a digital code for punched tape or telemetering. Model A9M can be operated in parallel with controllers or recorders. In operation, the signal to the digitizer is amplified and fed to a servomotor driving an analog-to-digital converter. Feedback of the servo's shaft position to the amplifier is accomplished by a differential transformer. The instrument can fit into a five-inch-square panel cutout. Face of the unit contains a dial which is directly connected to the encoder to provide continuous indication of the process variable. High and low alarm contacts can be incorporated into the digitizer for setting alarm points. **Swartwout Co.**, 18511 Euclid Ave., Cleveland 12, Ohio.

Circle 431 on Page 147

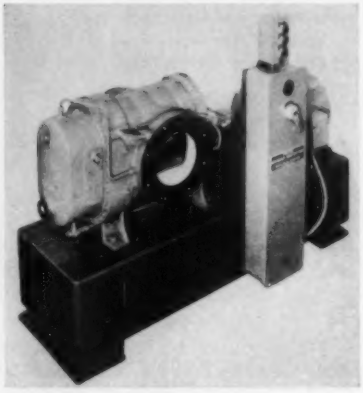


Rotary Paddle Feeder

Item 432

Unit is constructed with a series of paddles which revolve around a drum within a housing. It will deliver in an uninterrupted flow, material such as mash, meals, urea, various salts, and small granular particles. A regulating baffle at the discharge point aids in material flow. Capacities up to 30 cfm can be handled. The material is delivered vertically to permit installation of equipment directly below the bin opening. Sealed ball bearings are placed above the stream of material for protection from leakage. **Richardson Scale Co.**, Van Houten Ave., Clifton, N. J.

Circle 432 on Page 147



Booster Pump

Item 433

Unit is applicable in high vacuum pumping systems and also to supplement existing systems for: Rapid pump-down of simulated altitude chambers; high vacuum impregnation and drying; and arc furnace pumps where outgassing loads occur in 1 mu-10 mm range. The lobe-type unit is available in sizes from 230 to 12,000 cfm, has a

NEW SOLENOID VALVES *by Airmatic*

These corrosion-proof valves have only one internal moving part and a completely protected solenoid coil. The coil is fully sealed from air, oil, gas and water . . . and will not overheat on continuous duty. Coils for continuous or intermittent duty, a-c or d-c, are interchangeable.

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PRESSURE RANGE	1/16" ORIFICE: 0-500 PSI 3/16" ORIFICE: 0- 70 PSI	1/8" ORIFICE: 0-300 PSI 3/16" ORIFICE: 0-100 PSI
ORIFICES	1/16" THROUGH 3/16"	1/8" AND 3/16"
VOLTAGE	MOST A-C AND D-C	MOST A-C AND D-C
DUTY	CONTINUOUS	CONTINUOUS
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HEAT RISE	WITHIN UL LIMITS	WITHIN UL LIMITS

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Circle 688 on Page 147

pumping speed ranging from 1 mu to 10 mm of mercury absolute suction pressure. **General Vacuum Corp.**, 400 Border St., East Boston 28, Mass.

Circle 433 on Page 147

Adjustable Voltage Drive

Item 434

Applicable for machine tool feeds, processing equipment, and conveyor lines, drive features a wide speed range and close speed regulation. Unit can be adjusted to operate over a 50/1 speed range. For special applications, this range can be increased to 100/1. Drives are available as standard packages from ¾ to 40 hp. The control circuit contains only two control tubes—one for amplification, the other for voltage regulation. Other circuit elements are static or semiconductor components. Additional features of the drive include: Dynamic braking, dual voltage operation, and adjustable current (torque) limit control. **Square D Co.**, 4041 N. Richards St., Milwaukee 12, Wis.

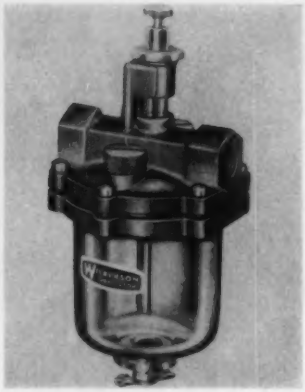
Circle 434 on Page 147

Photoelectric Counters

Item 435

Designed for continuous duty, line of electronic counters can be provided with photoheads which will operate at a distance up to 30 inches between the light source and photocell. The photoheads can be assembled so that jarring will not knock them out of focus. In the illustration shown, the counter has one glow transfer counting tube which will operate at 30,000 counts per minute. The unit can be furnished without this decade, or with additional tubes, depending on the speed required. **Veeder-Root Inc.**, Hartford, Conn.

Circle 435 on Page 147

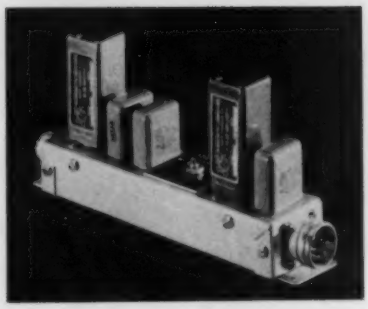


Air Lubricator

Item 436

Equipment can provide constant, controlled lubrication to all compressed air operated tools and equipment. It will inject an oil fog into the air system from as low as 1 cfm to 1200 cfm at any pressure within an operating range of 10 to 150 psi (for transparent bowls) and 10 to 250 psi (for metal bowls). Unit is designed to lubricate several pieces of equipment, due to a *flo-guide* which is inserted ahead of the venturi jet in the throat of the lubricator. In operation, as the air demand increases through the cutting in of additional tools and equipment, the *flo-guide* collapses against the venturi jet, permitting maximum air flow and offsetting pressure drop. The oil is atomized in the venturi jet and is transported with the air stream to the point of use. Lubricator has a visual metering chamber, can be furnished with either a nontamper or tamperproof adjustment. It is available in pipe sizes from ¼ to 2 inches; reservoir capacities are from 3.5 oz to 5 gal. **Wilkerson Corp.**, 1552 W. Girard Ave., Englewood, Colo.

Circle 436 on Page 147

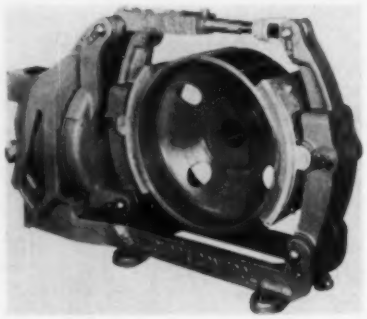


Transistor Amplifier

Item 437

High-gain, narrow-band voltage amplifier is constructed to operate from printed circuit resolvers and other low level sources with carrier frequencies from 60 cps to 20 kc. Model 214G is available in several versions, with input impedances from 1 ohm to over 1 megohm. For input impedances below 500 ohms, a matching transformer is used to obtain the best possible noise figure consistent with high gain. Microphonic properties of the amplifier are limited to those of the input transformer, which are negligible. **Electronic Div., Section 78, Taber Instrument Corp.**, 107 Goundry St., North Tonawanda, N. Y.

Circle 437 on Page 147



DC Motor Brake

Item 438

Line of dc motor brakes is available in 10, 13, 16, 19, and 23-inch wheel sizes. Top of the brake is hinged to provide equal distribution of the applied pressure. The mounting arrangement holds the shoes in spring-loaded sockets; does not depend on pins to connect them to the arms. A partial turn of a wrench releases pressure and the shoes can be slid out to the side without removing the wheel.

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No, not when it's compressed and put to work. And, wasted air adds hidden costs to manufacturing expense. Excessive air consumption by air control valves—especially "cross-bleed" or air lost to exhaust during valve shifting—can overload compressors and boost air supply costs.

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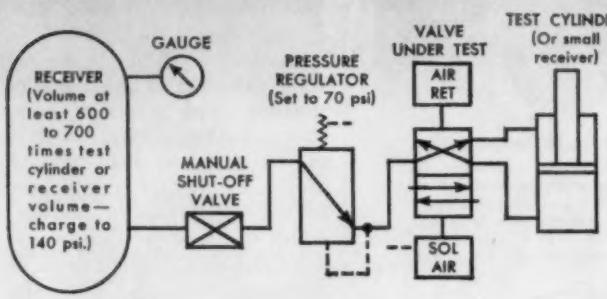
Before you buy any air control valve . . . compare air consumption and operating cost . . . compare performance . . . compare life . . . compare ease of maintenance . . . compare guarantees . . . compare, and you'll buy Valvair!

Valvair Corporation, Division of IBEC, 454 Morgan Avenue, Akron 11, Ohio. AA-3081



MAKE THIS SIMPLE TEST—connect the valve to be tested as shown, operate it at approximately 150 cycles/min. until receiver pressure drops from 140 to 90 psi and count the number of cycles operated on identical amounts of air. You'll find that Valvair Speed Kings will outperform other valves by as much as 6 to 1.

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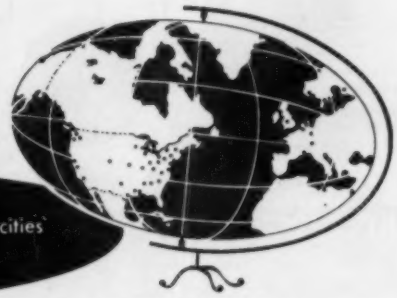

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Circle 689 on Page 147

made from the top of the brake. A single adjustment, with built-in indicator, sets the air gap. The magnet case and coil can be removed and replaced without releasing the brake. The main torque adjustment spring is at the bottom of the brake, totally shielded and protected. An internal screw adjustment keeps the adjusting stud from protruding beyond the initial position. **Clark Controller Co.**, 1146 E. 152nd St., Cleveland 14, Ohio.

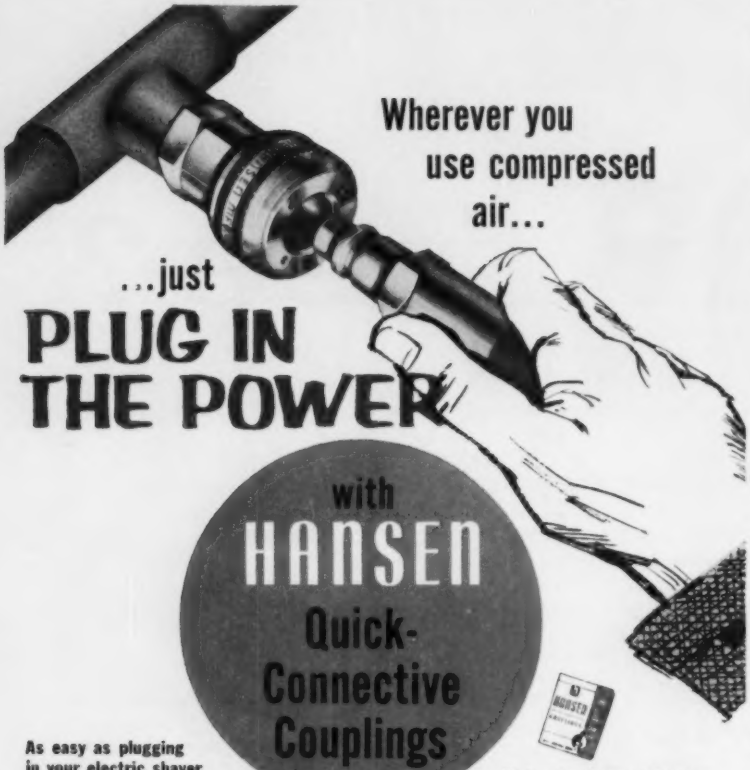
Circle 438 on Page 147

Pipeline Aftercooler

Item 439

Suitable for use in industrial air compressor service, pipeline aftercooler is rated for either 10 or 15 degrees temperature approach. Features of the unit include: Steel shell construction, corrosion resistant, removable tube bundle, packed floating head, and nonmetallic baffles. Unit has a counter current flow design (air in tubes flowing counter to water in shell) which permits the coldest (incoming) water to serve the coldest (outgoing) air for maximum heat transfer efficiency. A moisture separator uses centrifugal force to remove entrained water from the line. Aftercoolers are available in 54 models with capacities specified for operating pressures up to 125 psig for single and two-stage compression. **Ross Heat Exchanger Div., American-Standard**, P.O. Box 2081, Buffalo 5, N. Y.

Circle 439 on Page 147



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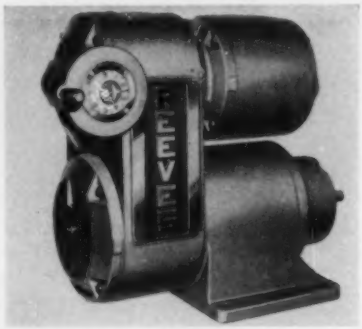
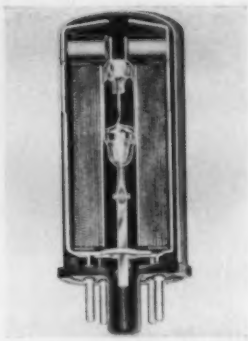


Variable Speed Drive

Item 440

Unit is capable of supplying infinitely variable speeds to all types of machinery and process lines. It is available with single, double, or triple-reduction gear reducers to produce speed ranges of from 2:1 to 8:1 within output speed limits of from 4 rpm to 3940 rpm. An indicator handwheel control provides infinite speed adjustment over the entire speed range. Features of the drive include: Magnetic drain plugs, baffle-type vent plug for leakproof reducer venting, and prealigned discs to provide automatic, correct belt alignment. Component parts in C-flow design (shown) or Z-flow design can be arranged into vertical, horizontal, 45-degree, and trunnion mounting on the floor, wall, or ceiling. **Reeves Pulley Co., Div., Reliance Electric & Engineering Co.**, 1225 Seventh St., Columbus, Ind.

Circle 440 on Page 147

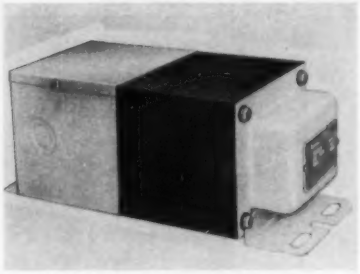


Mercury-Wetted Relay

Item 441

Design of mercury-wetted contact relay is always biased with permanent magnets which are adjustable for single-side stable or bistable operation. Operating speeds of Type HGS can be up to 200 cps or more. Sensitivity is as low as ±2.5 milliwatts for a bistable adjustment and as low as 5 milliwatts for a single-side-stable adjustment. Contact rating is 2 amp, 500 v, with a limit of 100 va. **C. P. Clare & Co.**, 3101 Pratt Blvd., Chicago 45, Ill.

Circle 441 on Page 147



Voltage Stabilizer

Item 442

Line of voltage stabilizers features an automatic overload or short circuit protection when the load current is increased in excess of the normal operating load. This line of instruments is designed for use on 60 cycle circuits. A parallel combination of a fixed capacitance and a magnetic core inductance stabilizes the output voltage and provides the required variable capacitive current. The addition of the compensating winding helps to balance the output circuit. A unit will operate within ±1 per cent of stabilized nominal output voltage even with a fluctuating input volt-

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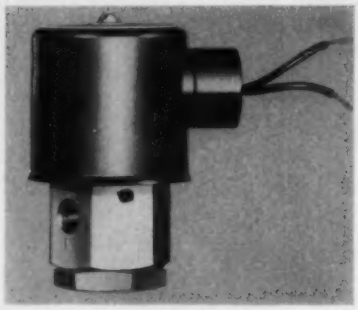
Circle 691 on Page 147

age ranging 30 per cent of nominal. It is said that voltage fluctuation can be corrected in less than 1/30 of a second. Stabilizers are available for 190-260 v input and 95-130 v input circuits. Capacities range from 15 va to 2000 va. **Acme Electric Corp.**, Cuba, N. Y.

Circle 442 on Page 147



Direct Lift Valve

Item 443

Single-seated, angle-type solenoid valve is applicable where a wide range of pressures is coupled with relatively little flow. Miniature unit (3¼ inches high) is machined from brass bar stock with a stainless steel plunger and point assembly, can be used for air, gases, water, oil, steam, and other media not harmful to brass. Valve features a direct lift operation which means the main valve ports open instantly when the solenoid is energized. Pressure range is from zero to 400 psi and pipe sizes are ⅛ and ¼-inch. **Atkomatic Valve Co. Inc.**, 545 W. Abbott St., Indianapolis 25, Ind.

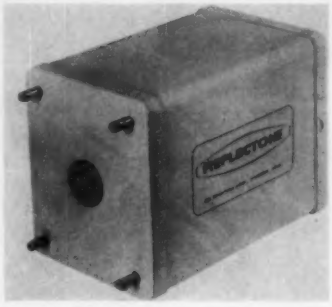
Circle 443 on Page 147

Tramp Iron Separator

Item 444

Device is constructed with a permanent magnet drum, provides tramp iron protection in process industries. It is also suitable for use wherever iron particles are to be removed from a granular product. The separator can be installed in any enclosed chute or spout conveying system. The separator uses a ceramic magnet material which has a high energy product, is light in weight, and has a great resistance to demagnetization. The drum is a revolving stainless steel cylinder inside a welded steel housing and carries material over the stationary magnet assembly. Tramp iron particles are picked up and rejected continuously and automatically, with no interruption of the material flow. Unit is available in a range of sizes with drum diameters from 12 to 24 inches. **Stearns Magnetic Products**, 635 S. 28th St., Milwaukee 46, Wis.

Circle 444 on Page 147

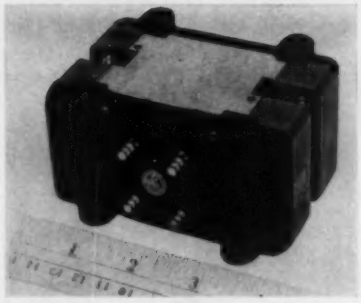


Servo Amplifier

Item 445

Reversible output amplifier is designed to operate from single or double speed synchro control transformers or from bridge networks. It can drive a variety of low-impedance, two-phase servomotors, delivering up to 10 w mechanical output. The self-contained unit has four mounting studs. All connections are made in the stud end to a hermetically-sealed header. These connections include: Input, output, stick-off voltage, and feedback windings for gain control and servo stabilization. Unit, designated Type III, can develop 30 v for a 1 v input and 70 v for a 2.25 v input. Amplifier operates from 115 v, 60 cps, is shockproof and moisture-proof. **Reflectone Corp.**, Stamford, Conn.

Circle 445 on Page 147

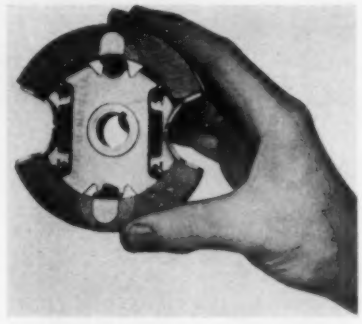


Torque Motor

Item 446

Adaptable to actuate hydraulic servo valves and other electromechanically-actuated devices, motor will deliver a 15-lb output force at midposition. It can be driven from vacuum tubes, transistors, or magnetic amplifiers. Input power for Model 106 is 4 w, stroke 0.020 inch, hysteresis less than 2 per cent. **American Measurement & Control Inc.**, 240 Calvary St., Waltham, Mass.

Circle 446 on Page 147



Centrifugal Clutch

Item 447

Unit is constructed with only four moving parts (two springs and two shoes), is suitable for use on high-inertia loads where smooth starting is essential. Clutch gives overload protection, also provides free-wheeling when the prime mover is stopped. When a smooth, gradual load pickup is required, the clutch can control the engaging speed of the load by rheostat control of the drive motor. Unit is available in capacities from 1 to 15 lb-ft, at from 1400 to 3600 rpm, in 7/16 to 1-inch bore sizes. **Magneto Div., Fairbanks, Morse & Co.**, Beloit, Wis.

Circle 447 on Page 147

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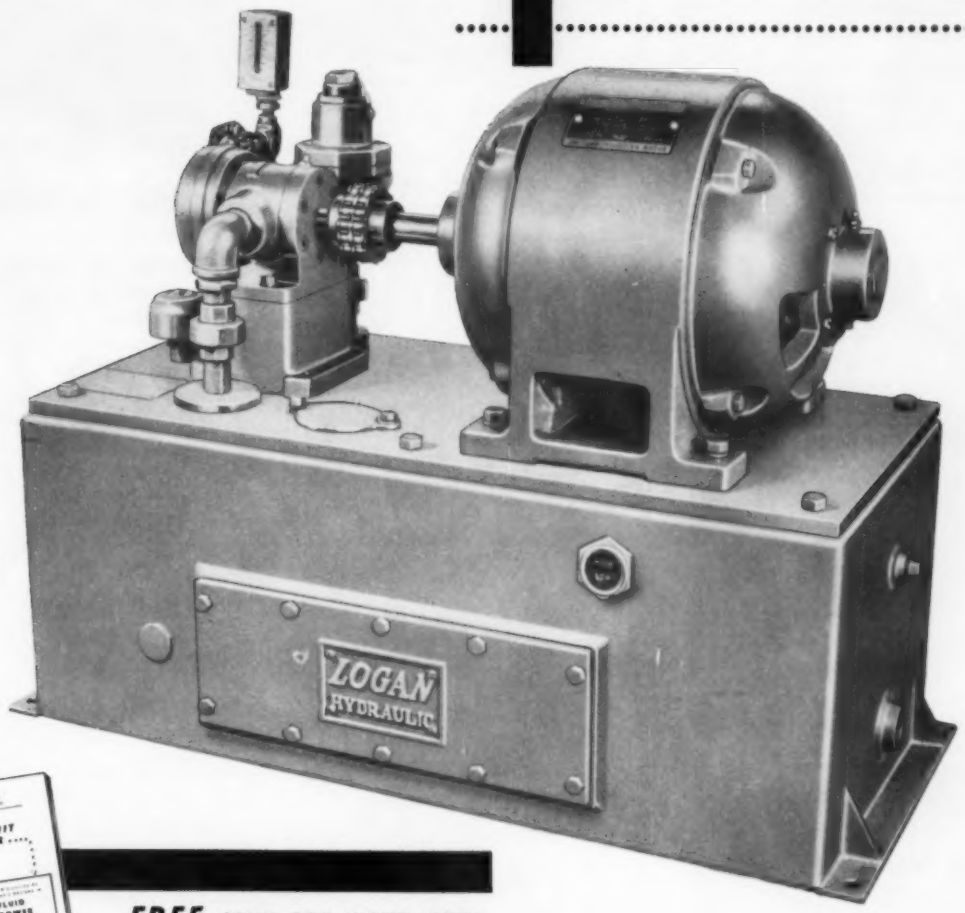
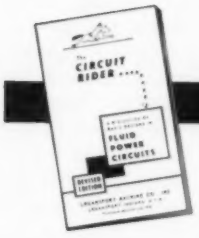


ILLUSTRATED—LOGAN MODEL 6031 HYDRAULIC POWER UNIT



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Circle 692 on Page 147

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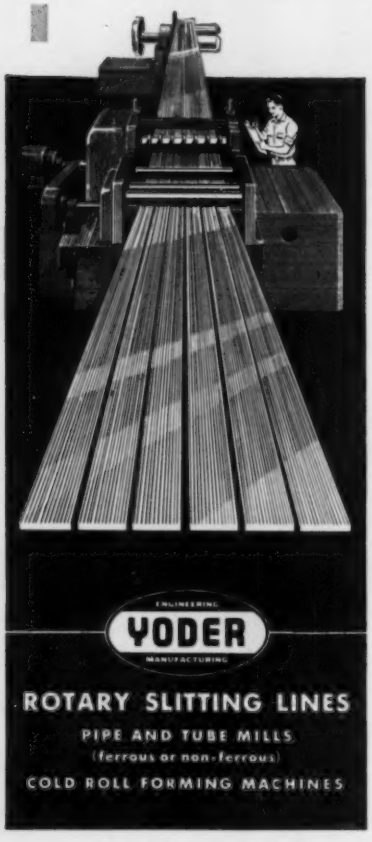
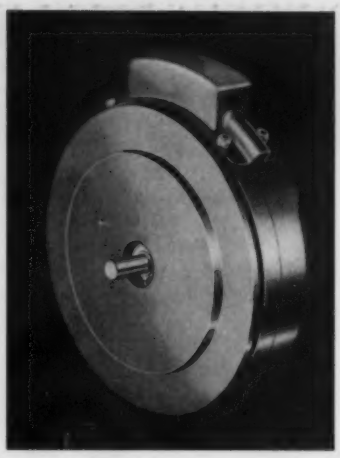


Circle 693 on Page 147

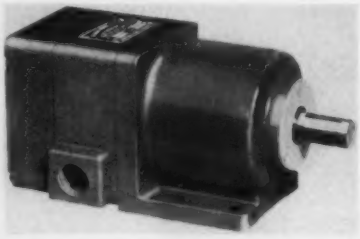


Shaft Encoder

Item 448

Device is capable of translating analog shaft position to true binary digital information, is applicable in computer control of automatic machinery. Miniature encoder provides 10-bit resolution with a 3½-inch disc which yields 1024 individual position representations per turn. This design will permit the control of linear machine feeds to within tolerances of 0.001 inch of the total travel. Control of the transition is accomplished by the combination of a disc pattern and a five transistor logic circuit contained in the encoder. The shaft of Model 740 is fitted with a synchro-type mount for precise location of the input shaft. Voltage requirements for the transistors are −6 v dc. Encoder will operate over a temperature range of −50 to 150 degrees F. **Librascope Inc.**, 808 Western Ave., Glendale, Calif.

Circle 448 on Page 147



Centrifugal Switch

Item 449

Device features an over-all adjustable speed range from 70 to 5000 rpm with the operating speed adjustable while the switch is running. Two separate sets of contacts can be adjusted for operation at different speeds so that two separate operations can be controlled from one speed sensitive switch. This feature makes it possible to perform two different functions at two different speeds. The glass fiber reinforced polyester resin enclosure of the switch makes it resistant to acid, alkali, salt compounds, and moist, corrosive atmospheres. It will also withstand severe shock impacts. **Euclid Electric & Mfg. Co.**, Madison, Ohio.

Circle 449 on Page 147

Magnetic Tachometer

Item 450

Applicable for control, monitoring, and measuring operations, device can convert a signal frequency from a magnetic transducer to a dc current proportional to frequency and rpm. The proximity pickup is not attached to any moving system component. Magnetic tachometer has a linearity of 0.25 per cent in ranges from zero to 60,000 rpm. It will operate from 115 v, 50 to 400 cps and 12 v dc sources. **Airpax Products Co.**, City of Plantation, Fort Lauderdale, Fla.

Circle 450 on Page 147

Industrial Conveyor Belt

Item 451

Industrial conveyor belting, made of Koroseal, is suitable for use on material which comes in contact with cutting oils and greases in metalworking plants; in chemical plants where belts handle wet, sticky materials; and also in pulp mills, glass plants, and plastic factories. It can be used in temperature ranges between 35 and 175 F. Covers on the belting are made of Koroseal and the belt carcass is neoprene

SIMPLIFY MACHINE DESIGN WITH THIS *Different* AIR CYLINDER

Save design time — save production costs. Eliminate cams, levers, gearing, linkages or other mechanical means for performing push, pull or lift motions. Design with air in mind.

The Bellows Air Motor is a complete electrically-controlled air cylinder power unit with directional valve and speed controls built in. It requires only one air connection which can be made with flexible hose. Compact, space saving, it fits well into crowded quarters or on moving machine elements. It is fast, responds to a starting impulse instantly. It is easily interlocked and synchronized with related machine movements. Its quality and reliability has been proven in more than quarter of a million installations.

The range of work it can do is limited only by the imagination of the design engineer.

Send for this free booklet

Here in these quick reading pages is the full story of The Bellows Air Motor — what it is doing for others, what it can do for you. Address Dept. AU-259 The Bellows Co., Akron 9, Ohio. Ask for Bulletin BM-25. In Canada, write Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ontario.

765-B-1

The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

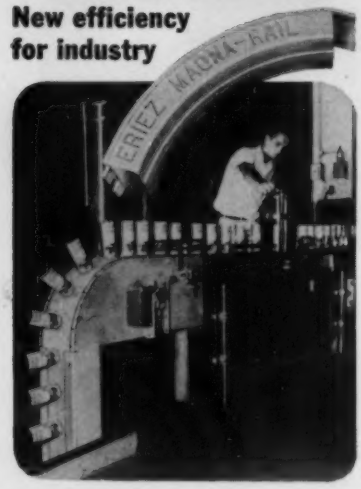
AKRON 9, OHIO

Circle 694 on Page 147

MAGNETS
PLUS
AUTOMATION
EQUALS
MAGNAmation®

New word from
ERIEZ

New efficiency
for industry



MAGNA RAILS. Lifetime powered, non electric magnetic elements that convert ordinary belt conveyors to *magnetic* conveyor elevators. Will convey ferrous items up inclines as steep as 90° — quickly, safely, with positive hold. Easily installed under existing lines, or incorporated into new equipment. Increases production. Reduces manpower needs. Saves valuable factory floor space.

VERSATILE MAGNA RAILS ARE AVAILABLE IN MANY MAGNETIC STRENGTHS IN VARIOUS BOLT-TOGETHER LENGTHS AND IN STRAIGHT AND CURVED SECTIONS, ASSURING YOU PROPER UNITS FOR SOLVING YOUR HANDLING PROBLEMS REGARDLESS OF SIZE OF PARTS.

Our men work closely with design engineers, OEMS, etc. If you need assistance, just contact us.

FREE! Big, 48-page booklet "Magnetic Ideas from Eriez". Loaded with idea-sparking illustrations, diagrams, installation photos. Send today!

FOR YOUR COPY, WRITE TO
Eriez Mfg. Co., 119-PA Magnet Dr., Erie, Pa.

ERIEZ

Circle 695 on Page 147

with a skim coat. When the belting is made with a friction surface back, Koroseal is used to impregnate the outer surface. The belting has a high oil resistance and can be easily cleaned. B. F. Goodrich Industrial Products Co., Akron, Ohio.

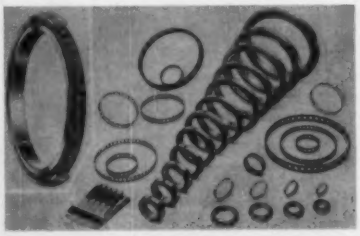
Circle 451 on Page 147

Hydraulic Panel

Item 452

Standard subplate components are of "building block" design with pressure, return, and drain lines manifolded within the block. The pressure, return, and drain line manifolds are drilled vertically through the blocks and are a continuous passage from block to block, sealed by a counterbored O-ring at each interface. Tie-rods placed axially through fluid passages have terminal fittings that either plug, or allow fluid line connection to the internal manifold. Remaining area in the passages is capable of handling 30 gpm of 150 ssu hydraulic oil flow. Petch Mfg. Co., 463 York, Detroit 2, Mich.

Circle 452 on Page 147



Thin-Section Bearings

Item 453

Retainer-type, instrument ball bearings are available in sixteen sizes with bores ranging from 3/8 up to 3 1/16 inch. One-piece retainers with maximum ball complements and continuous race shoulders without filling slots, are

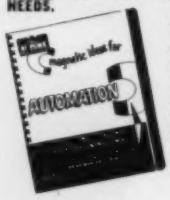
MAGNETS
PLUS
AUTOMATION
EQUALS
MAGNAmation®

New word from
ERIEZ

New
efficiency
for
industry

MAGNA ROLLS. Permanently powered, non electric automation units for use in magnetic conveying systems. Hold, control, elevate, change direction flow of ferrous materials — from small parts to large sheets. Can be used as head pulleys or in systems not utilizing belts. For *faster, shorter, safer* conveyor lines that move at peak speeds for peak production!

MAGNETIC STRENGTH IS GUARANTEED INDEFINITELY • NON ELECTRIC; NO WIRES, ATTACHMENTS, FUSES • NO MAINTENANCE • EASILY INSTALLED ON NEW OR EXISTING EQUIPMENT • LOW INITIAL COST; NO OPERATING COSTS • VARIOUS DIAMETER WIDTHS, STRENGTHS, CONTOURS, ETC., TO MEET SPECIFIC NEEDS.



Need assistance? Contact us; we work closely with design engineers, OEMS, etc., on models and pilot set ups.

FREE! Send for big 56-page "Magnetic Ideas for Automation" booklet. Packed with idea-sparking sketches for proved-in-use installations, etc.

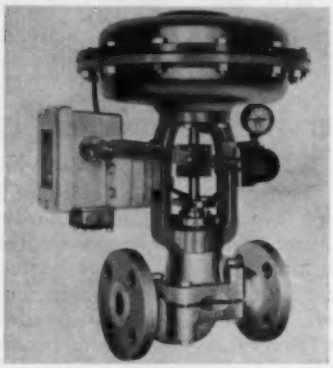
Eriez Mfg. Co., 119-PB Magnet Dr., Erie, Pa.

ERIEZ

Circle 696 on Page 147

said to provide greater capacity, long life, and low torque. Standard retainer is constructed of fiber-reinforced pressure-molded phenolic. Bearings are available in 52100 bearing steel or 440C stainless steel. **Split Ballbearing, Div., MPB Inc.**, Lebanon, N. H.

Circle 453 on Page 147



Motor Operated Valve

Item 454

Springless diaphragm motor operated valve is suitable for high pressure drops, flashing service, chemicals, and slurry applications. The design of the unit is said to eliminate friction in the motor, require less air pressure to operate, and supply a greater force to the valve stem itself. Operator has a single-seated split body design which provides a streamlined flow passage and eliminates erratic pressure variations in the flow stream. It is available in sizes from one to six inches. **Uniflow Valve Corp.**, 19 Quine St., Cranford, N. J.

Circle 454 on Page 147

Hydraulic Rollers

Item 455

Fluid-filled rollers, installed on a hydraulic conveyor, are capable of stopping material for assembly, inspection, labeling, packaging, or marking operations while the conveyor continues to run. The torque which the roller will transmit is limited to only the amount actually required to maintain material flow. Even though the conveyor continues to run, there is no damage to the conveyor or material. **Harry J. Ferguson Co.**, Jenkintown, Pa.

Circle 455 on Page 147

WITHOUT SIGNAL AMPLIFICATION

api VHS* MEASURING RELAYS

SENSE AND SWITCH ON SMALL INPUT

**Very High Sensitivity* with exceptional reliability are inherent characteristics of the A.P.I. measuring relay. It will actuate on inputs as small as 0.2 microampere or 0.1 DC millivolt to give you discrete switching action at the *precise* current or voltage value you specify.

The VHS measuring relay has the ability to differentiate between "normal and abnormal", "yes and no" on the basis of very minute electrical variations. In typical cases, it monitors 450 volts to ±5%; in another, 14 microamps to ±1 microamp.

Exceptional reliability and repeatability are achieved by the unique A.P.I. locking-coil design. At the point of contact, torque of the D'Arsonval movement is supplemented by the torque of the locking coil. Decisive switching action occurs with firm contact pressure. Contact resistance is low.

VHS measuring relays are available with high- and low-limit contacts, or either alone. Special models are available for excessive shock and vibration conditions.

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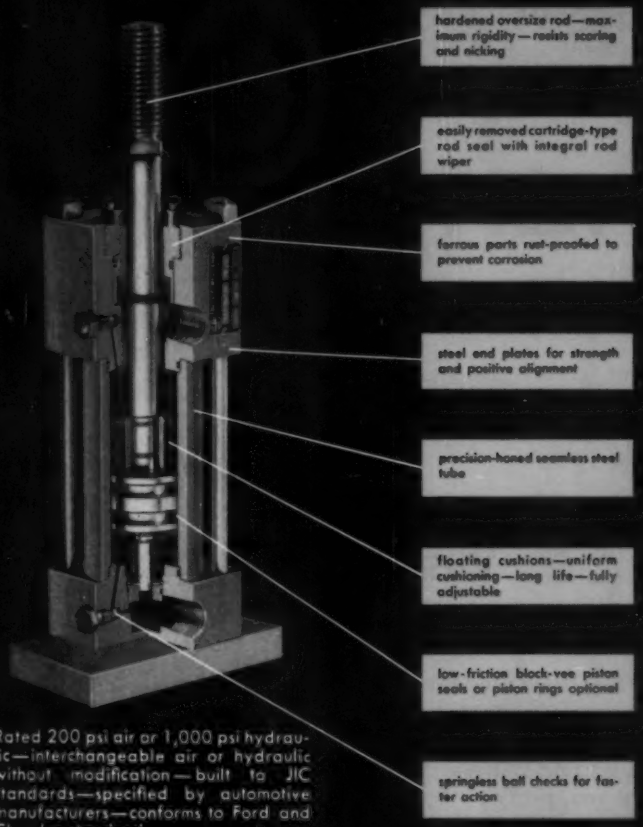
api ASSEMBLY PRODUCTS, INC.
Chesterland 27, Ohio

S.A. 1071

for performance...
dependability...
economy... specify SP

HEAVY DUTY AIR and HYDRAULIC CYLINDERS


hardened oversize rod—maximum rigidity—resists scoring and nicking
easily removed cartridge-type rod seal with integral rod wiper
ferrous parts rust-proofed to prevent corrosion
steel end plates for strength and positive alignment
precision-honed seamless steel tube
floating cushions—uniform cushioning—long life—fully adjustable
low-friction block-vee piston seals or piston rings optional
springless ball checks for faster action

Rated 200 psi air or 1,000 psi hydraulic—interchangeable air or hydraulic without modification—built to JIC standards—specified by automotive manufacturers—conforms to Ford and Chrysler standards.

If your service requirements are severe . . . if you need uniform operation, long trouble-free life, minimum equipment downtime . . . you need S-P *heavy-duty* air and hydraulic cylinders!

Want more proof? A phone call will bring our representative on the run! Prompt deliveries, too. The S-P Manufacturing Corporation, 30201 Aurora Road, Solon, Ohio.

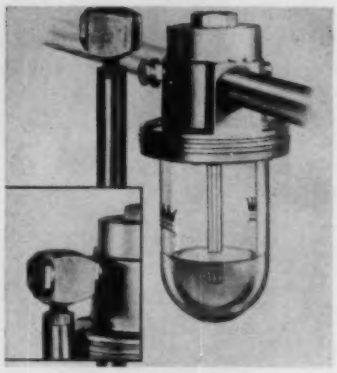
SP *for speed and performance*

Representatives in principal cities. Phone or write for Catalog No. 115.

Find us fast in the "Yellow Pages"

NON-ROTATING AIR AND HYDRAULIC CYLINDERS • ROTATING AIR AND HYDRAULIC CYLINDERS • POWER CHUCKS • COLLET AND DRILL PRESS CHUCKS • VALVES, ACCESSORIES

A BASSETT COMPANY • IN GREATER CLEVELAND • ESTABLISHED 1916

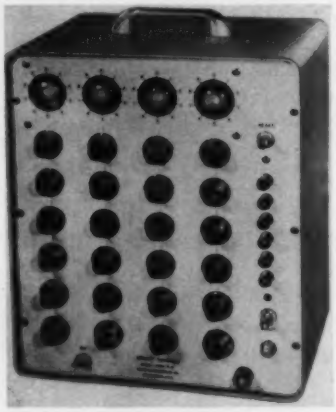


Remote-Fill Lubricator

Item 456

Device is designed to quickly fill hard-to-reach lubricator bowls, without stopping operation of the machine. Lubricator has a button-head fitting and a button-head coupler. The fitting can be installed on either side of the lubricator body and the coupler is mounted on the end of an extension of the oil delivery line. The two fittings are engaged by using the lubricator body flange as a guide. Oil is forced from a portable hand pump through the delivery line into the bowl. After filling, the two fittings are uncoupled by an upward movement of the extension. **Hannifin Co.**, Dept. 142, 501 S. Wolf Rd., Des Plaines, Ill.

Circle 456 on Page 147



Multiple Preset Counter

Item 457

Instrument is designed for applications where a machine or process is started manually and stops automatically at several preset counts in one cycle. Model 2020-4-6 has a 4-digit count of 9,999, will operate

at counting speeds of 4000 per second and presets one through six. Counter is constructed with a silicon power supply, uses a minimum of computer type vacuum tubes. The inputs supplied include photocell, switch closure, and pulse. Output is a DPDT relay with 5 amp contacts. A 105-125, 50-60 cycle power supply is required. **Freed Transformer Co. Inc.**, 1705 Weirfield St., Brooklyn 27, N. Y.

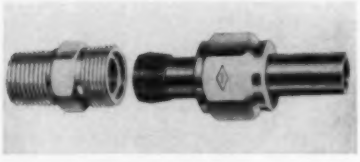
Circle 457 on Page 147

Process Timer

Item 458

Timer signals an operator in a function where a sequence of timed steps must be performed by the operator. Mounted on or near the machinery, the timer is set for the length of the process. When the process is completed and the operator is needed, either a red light or a bell signals the operator. The light stays on until it is reset to time the next step in the process. The timing program can be adjusted to time steps of unequal duration. Standard time ranges are 1, 2, or 3 hrs. **Bildwel Manufacturers**, Tecumseh, Mich.

Circle 458 on Page 147



Flareless Tube Fitting

Item 459

Designed with a butt joint, flareless tube fitting has no tube entry into the throat of the fitting, elimi-

simplified
LOAD CELL WEIGHING

HOWETRONIC SYSTEM FOR SPEED, ACCURACY, STABILITY

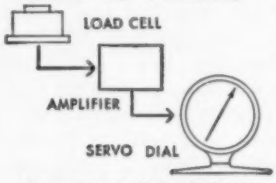
Now, *you* can enjoy modern, accurate load cell weighing with a practical, trouble-free HOWEtronic system. Howe has simplified and combined the best modern weighing elements into *complete*, rugged packages engineered for your application, no matter how difficult the operating conditions.

Howe's matched components guarantee *all* the advantages you should get from a load cell system: fast, accurate weighing with no hunting or overshoot; fewer adjustments; no waver, inertia, or time delay. Installation of factory-calibrated systems by factory-trained men is simple and rapid. Once installed, they stay within calibration and a minimum of maintenance is required.

From 1000 pounds to hundreds of tons, rugged HOWEtronic load cell systems can guarantee speed and accuracy without resorting to critical mechanical or electrical designs. High cell output insures stable performance. HOWEtronic load cells will accommodate substantial off-center or cross loading with no loss of accuracy.

Write today for complete information about this simple, practical approach to your difficult weighing problem.

HOW IT WORKS



Pressure on the hydraulic load cell is transformed into an electrical signal directly proportional to load. This signal is fed into a simple, rugged servo system which positions a remote dial indicator, recorder or control. Accuracy is within established commercial tolerances; speed of response permits 2 to 6 second weighing with no hunting or overshoot. Only ½ second is required for check-weighing with control.

HOWE

THE HOWE SCALE CO., RUTLAND, VERMONT

A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

Circle 699 on Page 147

OBSOLETES
MECHANICAL SWITCHES

Responds to ferrous or non-ferrous metals without contact

Used for positioning or counting parts and controlling machinery

Electro Proximity Pickup and Control outlasts mechanical switches. Proven on production lines, conveyors and machinery. This inexpensive system detects stationery or moving metal pieces 1/10" diameter or larger. Wide selection of stock pickups.

Advantages over other switches

- no mechanical linkage
- meets JIC requirements
- operates for years without attention
- oil and water proof
- low pickup cost (from $13.50)
- pickups to operate 100' from unit

Proximity Transducer System includes pickup, control unit and cable.

Write for Engineering Data

Electro

ELECTRO PRODUCTS LABORATORIES

Sensing Elements for Control Counting Speed and Displacement Measurements

4501-A Ravenswood, Chicago 40, Ill.

Canada: Atlas Radio Ltd., Toronto

9010

Circle 700 on Page 147

nating the need to spring the tubing in making connections. The fitting is available in three metals—brass, steel, and stainless steel. It is constructed so the sleeve can be put on in only one direction, providing a foolproof assembly, **Imperial Brass Mfg. Co.**, 6300 W. Howard St., Chicago 48, Ill.

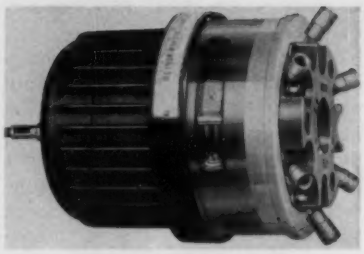
Circle 459 on Page 147

Heat Control System

Item 460

Suitable for heating or cooling applications, temperature control valve system (illustration shows main control valve) can handle from 2000 to 50,000 lb of steam per hour, or 2300 gallons of water per minute. The system can control temperatures from 35 to 450 F and give dead end shutoff. It is suitable for pressures to 125 psi. In operation, the discharge line from the needle valve is directed into a low pressure region to permit the main valve dome pressure to bleed off properly. To start up the system, the gate valve is closed and the needle valve is fully opened. Then the globe valve in the bypass line is gradually opened and steam enters the system. The flow of steam is adjusted through the heat exchanger to a minimum or normal flow rate. When the temperature reaches approximately 75 per cent of the set point, the globe valve in the bypass line is shut off and the gate valve is opened. There are two types of pilot and main valve action available: TCV normally closed, DCV normally open; and TCV normally open, DCV normally closed. **Jordan Corp., Div., OPW Corp.**, 6013 Wiehe Rd., Cincinnati 13, Ohio.

Circle 460 on Page 147

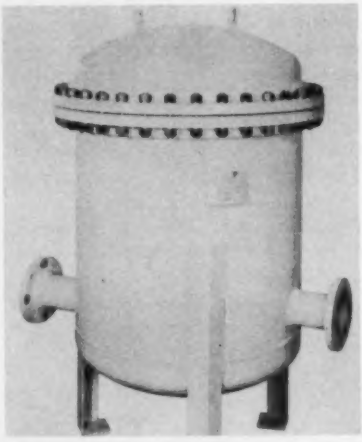


Transmitter-Receiver

Item 461

Designed for continuous duty operation under adverse environmental conditions, unit is capable of performing control and registering functions in the petroleum, processing, and chemical industries. Model A is suitable for either transmitting continuous rotational movement or for transmitting angular positions over a 5-wire electric circuit. The stator and rotor windings are completely encapsulated and the unit can be immersed in water without loss in insulating quality or rust development. Transmitter-receiver is rated for 115 v, 50-60 cps. Input at max torque of 2.75 oz-in. is 0.2 amp. Static error is ±1 degree; dynamic error ±½ degree. Maximum speed is 500 rpm. **Rotron Controls Corp.**, Woodstock, N. Y.

Circle 461 on Page 147



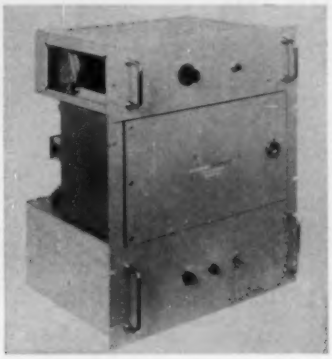
Gas Filter

Item 462

Compressed gas filter is available in seven models for flow rates of 100 to 2500 scfm. The filter is installed between the compressor and dryer to remove both oil vapor and entrainment. Unit is designed so

that the entering gas releases its content of oil and water droplets and foreign particles by centrifugal force. The oil vapor is removed by passage of the gas through an adsorption bed of activated alumina. This activated alumina is contained in a removable metal basket which can be taken out for reactivation. The frequency of reactivation depends on the amount of oil vapor in the compressed air or gas being filtered. **Kahn & Co. Inc.**, 547 Windsor St., Hartford 1, Conn.

Circle 462 on Page 147



Digital Buffer Storage

Item 463

Unit can store up to 1092 characters of eight bits each and operates at a 100 kc rate. Characters are loaded and unloaded sequentially with all bits of each character being handled simultaneously. Features of Model 1092-BQ8A are: Interlaced load and unload, internal checking circuits, integral power supply, solid state elements throughout, and simple installation. **Telemeter Magnetics Inc.**, 2245 Pontius Ave., Los Angeles 64, Calif.

Circle 463 on Page 147

Miniature Photocells

Item 464

Line of miniature photoconductive cells is suitable for various electronic, automotive, and industrial applications. Each cell has a rectangular sensitive surface 3/16-inch long and 3/64-inch wide, and can be supplied with either end or side view. It can be soldered directly into a circuit without using a heat sink. Each cell has a high ratio of light to dark current at low lev-

Smooth, quiet power transmission for heavy loads—

H & S Herringbone Speed Reducers

The Herringbone gear design provides continuous tooth action — eliminates end thrust.

Built for heavy load conditions, Horsburgh & Scott Herringbone Speed Reducers give you dependable economical service. They're available in single, double and triple reduction units. Check these 9 points of superiority:

1. Overall design conforms to AGMA specifications.
2. All bearing loads are balanced, due to the symmetrical design of the gearing.
3. Oversize bearings and low speed shaft provide tremendous overhung load capacity.
4. Heavy wall and base-pad thickness provides extra housing rigidity.
5. Housing designed with box-type construction for maximum thermal capacity.
6. Every gear is accurately sized and then cut on a modern Sykes continuous tooth gear generator.
7. All pinions are integral with the shafts and are made of heat treated alloy forgings.
8. Dust and oil-proof seals are provided on shafts extending outside the housing.
9. Splash lubrication floods all bearings and gears.

You'll find a wealth of information in our Catalog 55 describing our complete line of Speed Reducers. Write for it, or ask your nearby H & S representative.

THE HORSBURGH & SCOTT CO.
GEARS AND SPEED REDUCERS
5112 Hamilton Avenue
Cleveland 14, Ohio

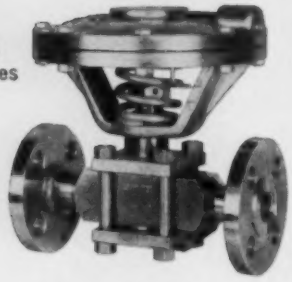
Circle 701 on Page 147

MINIATURE VALVES

501 Series

Valves Shown One-fourth Actual Size

526 Series



RUGGED

"BANTAM"

THROTTLING CONTROL VALVES

Compact throttling controls of the 501 series have one-piece barstock bodies with screwed ends and are available with linear, equal percentage or quick-opening plug characteristics. This series offers six operators, direct and reverse acting, including two with positioners.

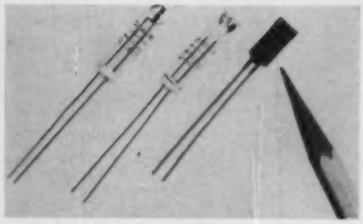
The 526 series includes 6 body styles in globe, angle and 3-way design — with screwed or flanged ends. Four bonnet types cover standard, high or low temperature and packless applications. Six control operators are offered with up to 50 square-inch diaphragms.

	501	526
Pressure Rating	1000 psi (at 450°F)	1000 psi (at 450°F)
Temperature Rating	−70°F to +450°F	−70°F to +450°F (750°F with finned bonnet)
Maximum Cv.	0.63	10.0 (1" connections)
Lift	1/4"	7/16"
Seat Area	0.038 sq. in.	up to 0.601 sq. in.
Connections	1/8", 1/4", 1/2" N.P.T. Standard (others available)	1/4" to 1" N.P.T. 1/2" to 1" flanged

Send for the BANTAM Catalog No. B-1 and other technical data on Dahl pneumatic and hydraulic valves.

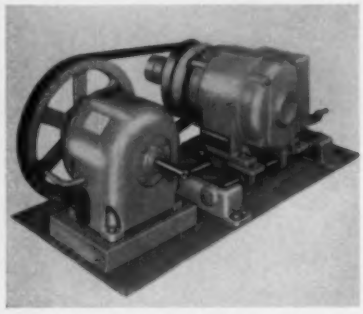
George W. Dahl Company, Inc.
86 Tupelo Street
Bristol, Rhode Island

Circle 702 on Page 147



els of illumination and conducts well with both polarities of voltage. The photoconductive elements consist of two types—polycrystalline cadmium sulfide and cadmium selenide. Power dissipation is 50 milliwatts for plastic units and 75 milliwatts for glass types, with ambient temperatures ranging from −50 to 75 C. **Clairex Corp.**, 19 W. 26 St., New York, N. Y.

Circle 464 on Page 147



Variable Speed Drive

Item 465

Drive uses a 4-speed geared transmission, can power equipment such as automatic welding positioners, buffing and polishing machines, conveyors, proportioning pumps, etc. The drive assembly is powered by an electric motor, has a self-adjusting variable pitch pulley on the motor shaft which is belted to a companion pulley on the 4-speed transmission input shaft. It is available in different motor and transmission combinations to provide speed variations from 12 to 1, to as high as 25.7 to 1. There are eight horsepower ratings (from ½ to 7½).

Maximum output speed is obtained when the motor is moved toward the driven machine by turning the handwheel on the adjustable motor base and allowing the V-belt to run at the largest diameter of the variable pitch pulley. Minimum output speed is obtained by turning the handwheel in the opposite direction, moving the motor away from the driven machine and varying the speeds infinitely until the minimum speed is reached. Infinite number of speeds between the maximum and minimum are obtained by shifting the gearshift drive into second or third speed and turning the handwheel. **Lima Electric Motor Co. Inc.**, Dept. 286, Lima, Ohio.

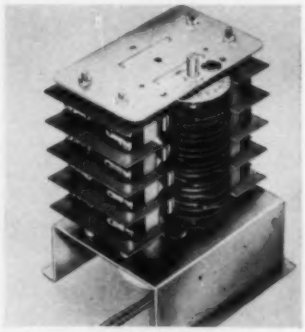
Circle 465 on Page 147

Vertical Shaft Motor

Item 466

Line of vertical solid shaft motors is furnished in sizes from 1 to 800 hp. The different models are: Open dripproof, totally enclosed, and explosionproof. Mountings are made to meet NEMA ratings. Single phase models are available in sizes ranging from 1 to 5 hp, and polyphase from 1 to 800 hp. Part-winding start models are available in 20 to 800 hp. **Electric Motor Div., A. O. Smith Corp.**, Tipp City, Ohio.

Circle 466 on Page 147



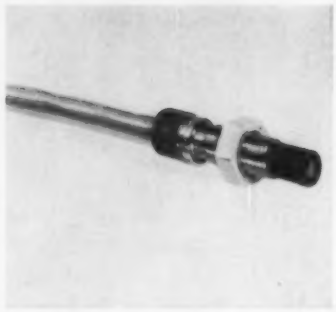
Cycling Timer

Item 467

Cycling timers provide quick adjustability of up to 8 independent

timed intervals. The throws of each load switch are controlled by separate cams, are adjustable through 180 degrees. Cam setting is indicated on a dial in per cent of full cycle time. Type 511 provides from 1 to 3 load switches, Type 520 from 4 to 8. Switching accuracy is within 1½ degrees for any one circuit, 3 degrees between any two circuits. Load switches are rated for 20 amp at 125 or 250 v ac, the motor is rated for 115/230 v, 25, 50, and 60 cycles. Timers are available from 6 seconds to 48 hours. **Cramer Controls Corp.**, Centerbrook, Conn.

Circle 467 on Page 147



Proximity Pickup

Item 468

Capable of detecting both ferrous and nonferrous metal parts having a diameter of less than 1/10 inch, miniature proximity pickup is designed for use on machines using coating oils or coolant. It can also be used while submerged; the 10 ft cable is potted in place for resistance to water and oil. When connected to a proximity control unit with a shielded connecting cable, the pickup can detect stationary metal objects. Each time a metallic workpiece is in close proximity to the pickup, the connected control unit provides an electrical pulse to operate associated electronic or mechanical production equipment.

The unit can also detect moving metal pieces passing the pickup at a rate of up to 60,000 per minute. Operating clearance of metal pieces over ⅜-inch in diameter are up to ¼-inch. The pickup is available in two styles. **Electro Products Laboratories**, 4500 N. Ravenswood Ave., Chicago 40, Ill.

Circle 468 on Page 147

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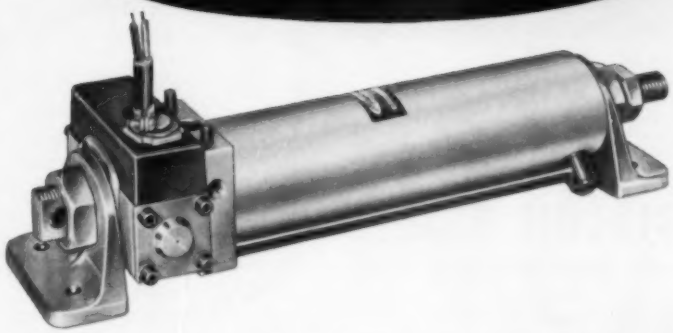
VIH (VALVE-IN-HEAD) CYLINDERS



Here's a combination that's hard to beat—a performance-proved industrial air cylinder with its own built-in directional and exhaust speed control valves—in a single, compact "package". Check these important features:

- **BUILT-IN DIRECTIONAL CONTROL VALVES...** your choice of four control combination; double solenoid, single solenoid with button bleeder return, double button bleeder, or double remote pilot pressure operation.
- **BUILT-IN EXHAUST SPEED CONTROLS** with automatic Nylon lock.
- **INTERCHANGEABLE MOUNTINGS...** front or rear flange, low or high "L" foot brackets, rod and cylinder clevis.
- **SINGLE CONDUIT CONNECTION** for double solenoid unit.
- **AVAILABLE WITH CUSHIONED STOP** either or both ends.
- **PERFORMANCE-PROVED MODERNAIR CONSTRUCTION**

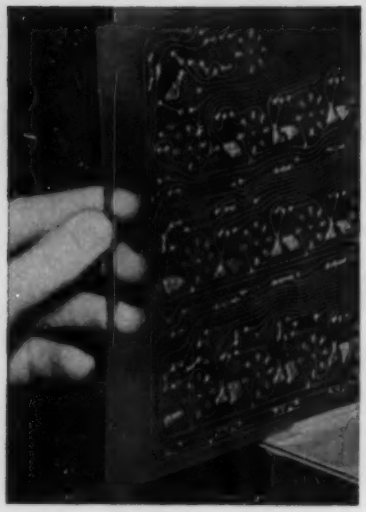
Condensed Specifications

DIAMETERS: 1½", 2", 3"
ROD SIZES: ½", ⅝", ¾"
MIN. OPERATING PRESSURE: 20 p.s.i.
SOLENOID POWER REQUIRED: 10 watts
MAX. OPERATING PRESSURE: 150 p.s.i. (solenoid) 200 p.s.i. (bleeder or pilot pressure)
SOLENOID COILS AVAILABLE: (ac) 8-10, 110, 220 v. (dc) 12, 24, 30 v.

Call your local MODERNAIR sales outlet (see Modernair trademark under "CYLINDERS" in the yellow section of your phone book) or write us today for complete data bulletin; please address Dept. C-2.

Modernair **CORPORATION**
400 Preda Street · San Leandro, California
MEMBER NATIONAL FLUID POWER ASSOCIATION

Circle 703 on Page 147



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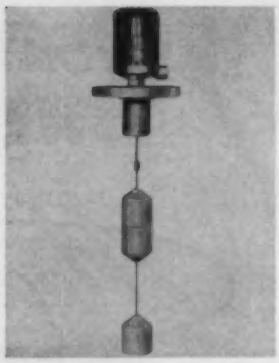
Circle 704 on Page 147



Liquid Level Control

Item 469

Device is adaptable for pump control to either fill or empty tanks, sumps, or vessels. It is a top-mounted control with a flanged or screwed mounting. Models A-102-F (shown) and A-103-F are designed for flanged mounting and Models A-102 and A-103 are designed for screwed mounting. Specific gravity ranges for the flanged mounting units begin at 0.5, depending on the type of displacers used and the operating temperature of the liquid being controlled. The displacer is of glazed porcelain. If conditions require a different type, a Karbate (chemically inert impregnated carbon) displacer is available, and also a stainless steel displacer. **Magnetrol Inc.**, 2110 S. Marshall Blvd., Chicago 23, Ill.

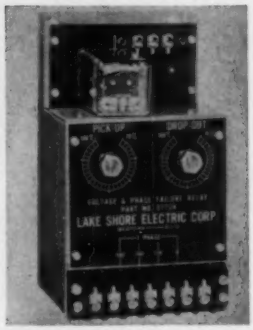
Circle 469 on Page 147

Hydraulic Filter

Item 470

Designed for hydraulic systems, line filter will prevent minute particles of dirt from causing wear in pumps, valves, and machine components. The unit is equipped with a replaceable filter element which has an initial particle selection rating of from 3 to 40 mu. Dirt particles as small as 0.000118 can be removed from the hydraulic lines. A fliptop cap on the filter housing provides an easy way of changing filters. The fliptop cap is suitable for working pressures up to 250 psi. Other units, furnished with 2-bolt caps are rated at 500 psi, 1000 psi, and 2000 psi. Filters up to 150 gpm capacity are available. Maximum temperature rating for most models is 275 F. **Schroeder Brothers Corp.**, McKees Rocks, Pa.

Circle 470 on Page 147



Voltage Sensing Relay

Item 471

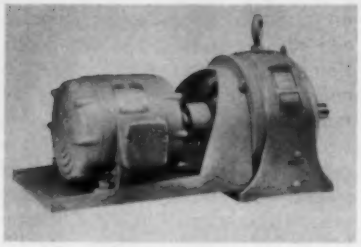
Device can be used to protect industrial motors, machine tools, and process equipment. Differential voltage sensing unit uses a simple printed circuit with a plug-in relay to open and close circuits. A zener diode and transistors are used in the sensing circuit. Control range of 70 to 100 per cent of rated voltage for both drop-out and pick-up with a minimum one-volt differential can be obtained. Relay is rated for dc service of both 6 to 49 v, and 50 to 250 v. It is available in open models or with NEMA type-2 enclosures. **Lake Shore Electric Corp.**, 205 Willis St., Bedford, Ohio.

Circle 471 on Page 147

Motorized Gear Drive

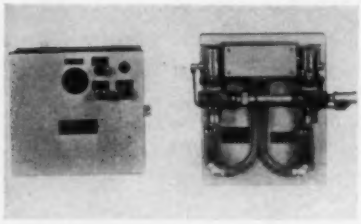
Item 472

Device, designated Line-A-Spede, consists of a gear reducer powered by a motor which is mounted on a shelf and attached to the reducer. Double, triple, and quadruple reduction gear units, with ratios up to 1487 to 1, are available for motor ratings of 1 to 75 hp. The mo-



tor can be replaced by disconnecting the coupling between the motor and reducer. Units are available for horizontal, vertical, flange, incline, sidewall, or ceiling mounting. An optional component available is a backstop, to prevent reversed rotation. **Louis Allis Co.**, Dept. P, 427 E. Stewart St., Milwaukee 1, Wis.

Circle 472 on Page 147



Press Control System

Item 473

System is designed to prevent tooling damage on automatic equipment such as presses, brakes, shears, and indexing units. It can be adapted to new equipment and existing equipment. System includes a prewired valve package, prewired control panel assembly, limit switches, and pushbutton switches. It uses two separate electrical, pneumatic, and mechanical control circuits operating in tandem. These parts are completely interlocked so that failure of one or more control components will automatically stop the machine at once or at the end of the cycle. The next cycle will not begin until the fault is located and corrected.

Two poppet-type air valves, two antirepeat relays, two valve relays, and two sets of limit switches are monitored at the end of each cycle. Air valve operation is sensed by external limit switches, actuated by valve stem extensions. **Textrol Inc.**, 4015 Prospect Ave., Cleveland 15, Ohio.

Circle 473 on Page 147

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Circle 706 on Page 147

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BEDFORD'S

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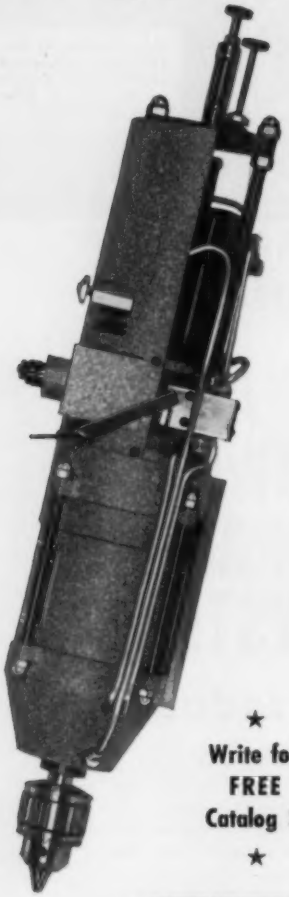
DRILLING UNIT

- MOST RIGID SPINDLE BUILT.
- CONSTANT SPEED and TORQUE.
- POSITIVE EVEN FEED.
- COMPACT! . . . . . POWERFUL!

. . . up to 3 HP in a 6" Frame . .
. . . up to 10 HP in an 8" Frame



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Indicating Controller

Item 474

Temperature regulator can pneumatically control air and liquid temperatures in a variety of industrial processes. A diaphragm-operated valve regulates temperature or pressure. Changes in the process under control are sensed by a remote nitrogen-filled bulb connected by a capillary to the controller. The changes are relayed by the controller to the valve, which modulates the heating, cooling, or pressure medium to keep the process at the desired point. In the event that the pilot valve becomes clogged, the operator can press the restriction cleaner to clear the line and keep the instrument working. The controller is available in different models with a temperature range from −25 to 135 F to 150 to 375 F; throttling range is adjustable from zero to 35 per cent. Air consumption with stable value position is 25 cubic inches of free air per minute. **Powers Regulator Co.**, 3411 Oakton St., Skokie, Ill.

Circle 474 on Page 147

DC Voltage Supply

Item 475

Miniature dc voltage supply, designed for use with a dc receiver on company's electronic recorder, can also be used on other potentiometer type recorders, bridge circuits, and industrial measuring potentiometers. The instrument is a two-stage voltage stabilizer with a rectifier. The first stage consists of a rectifier and voltage reference tube. This tube acts as a prestabilizer for the second stage. Stability of the unit is ±0.05 per cent for ±20 per cent supply voltage variations; ±0.08 per cent maximum drift over 10,000 hours of operation; ±0.0015 per cent maximum per degree Centigrade change in ambient temperature. Standard output is 1 v dc at 2 ma into a 500 ohm load. **Hays Corp.**, Michigan City, Ind.

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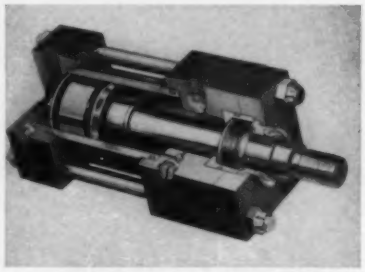


Hydraulic Cylinder

Item 476

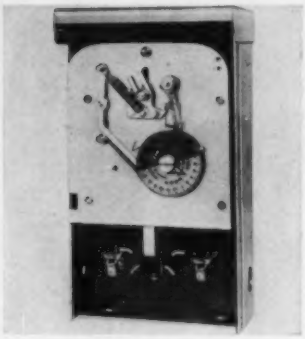
Line of hydraulic cylinders provides 19 basic mountings with bore sizes from 1½ to 12 inches for 3000 psi. A feature of the cylinder is the expansion-type tube seal which is said to prevent extrusion at shock pressures. The concentric piston is constructed in one-piece, uses self-compensating U-cup seals. Multiple V-ring rod seal needs no adjustment, is spring-loaded to maintain a predetermined tension. The cushion adjustment screws and ball checks have identical seats, and can be interchanged. **Nopak Div., Galland-Henning**, Milwaukee, Wis.

Circle 476 on Page 147

Time Switch

Item 477

Heavy duty time switch is unaffected by vibrations from machine operations. Switch is equipped with a synchronous, self-starting motor with a motor current consumption of 3 w. The motor will maintain synchronous speed at temperatures



from −20 F to 150 F. Switch is rated for 55 amp at 120/240 v ac. Dials are available with four trippers for 2 *On* and *Off* operations daily. The minimum *On* period is ½ hour and the maximum *On* period is 23¼ hours. An optional feature is an omitting device with a 7-day dial for eliminating the *On* operation on selected days. **Paragon Electric Co.**, Two Rivers, Wis.

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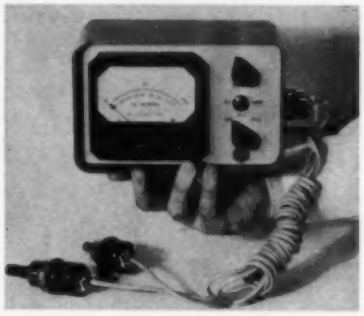


High Vacuum Gage

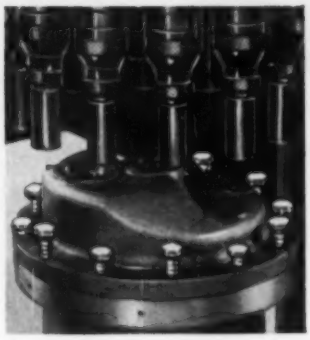
Item 478

Applicable on systems for vacuum drying, impregnation, leak detecting, or thermometer filling, thermocouple gage with a matching control will cover a range from 2500 to 1 micron absolute, with direct and continuous indication of total pressure at either of two points. Response time for the gage (Model 521) from 1 to 1000 microns is less than three seconds. Unit is said to be unharmed by operation at pressures up to 60 psi. A two-station gage control (Model 721) supplies the power to and interprets the output from the gage. Control has a large meter, with a pressure scale calibrated directly in microns and a filament current scale calibrated in milliamperes. Power required to operate the unit

THE NEED + THE IDEA = THE PRODUCT

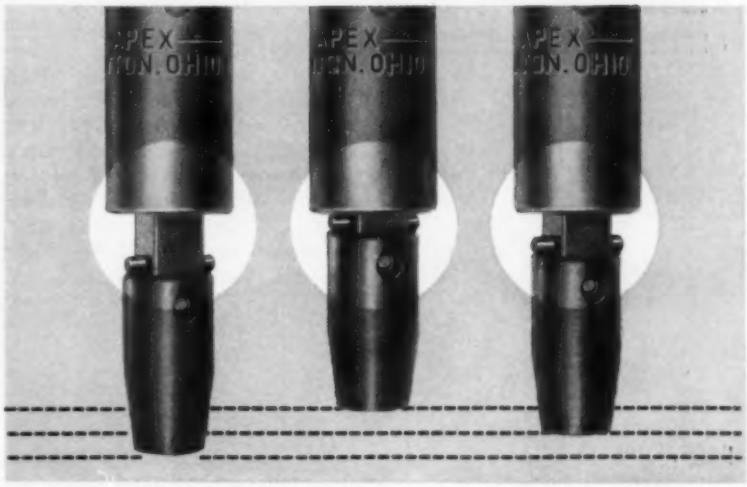
THE NEED

On multiple tool operation, where fasteners are positioned manually, the distances between sockets and mating fasteners will vary. Despite this variance, all the fasteners must be run in simultaneously and securely, without impairing the workpiece, fastener or tool.



THE PRODUCT

APEX CLUSTER SOCKETS



The Apex cluster socket, specifically designed for multiple tool applications, automatically compensates for any variation in fastener height. As the bank of power tools moves up to the fasteners, the spring-retracting action of each Apex cluster socket "levels" the fasteners, insuring uniform, positive seating and eliminating any possibility of cross-threading.

At Apex—the authority on fastening—the need creates an idea, closely followed by a new product. What's your need for special fastening tools? Our new Catalog 30-D lists several Apex "specials", one of which may solve your fastening problem—and your cost problem as well! Write, on your company letterhead please, for your copy.

APEX FASTENING TOOLS

SCREWDRIVING • NUT RUNNING • SPECIAL

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Circle 708 on Page 147

NEW
DIXON AUTO-TORQUE Driver

SCREWS AND NUTS
AUTOMATICALLY DRIVEN
WITH PRECISE TORQUE CONTROL

Gives you . . .

1 Complete control of screws from parts feeder to chuck, until threads are started. No dependence on gravity to load chuck.

2 Exclusive built-in sensing, assures that screw is driven. Automatically retracts driver only after attaining proper torque.

3 Complete automatic cycle, requires only a touch of the pedal.

4 Torque accuracy within 8%, comparable to most precise hand-torquing methods.

5 Clutch free-wheels after driving. Operator cannot vary the torque.

6 Two ranges of torque available 0 to 84 inch-pounds and 48 to 120.

7 Work height adjustment with 14" range, can be made without in any way disturbing the machine adjustments.

Model SD-100, above, tooled for any standard screw up to 1/4" thread size. Special tooled feeders available. Model SD-101, without floor column, provides a complete automatic station. Maximum width 6 inches.

The new DIXON *Auto-Torque Driver* includes all the features of the DIXON Auto-Positioner, and has an efficient space-saving air motor with an adjustable-torque clutch. These features provide for positive handling, giving new efficiency in driving screws and nuts.

ASK FOR BULLETIN SD-81 illustrating and describing design and operating features and giving specifications.

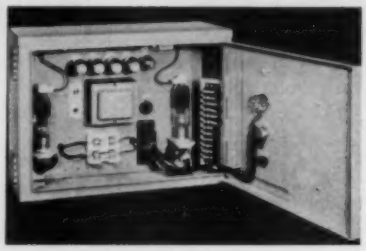
DIXON AUTOMATIC TOOL, INC.
DIXON 2312 - 23rd AVENUE ROCKFORD, ILLINOIS

Equipment for Automatic Parts Handling and Assembly

Circle 709 on Page 147

is less than 6 w at 115 v, 60 cycles. **NRC Equipment Corp.**, 160 Charlemont St., Newton Highlands 61, Mass.

Circle 478 on Page 147

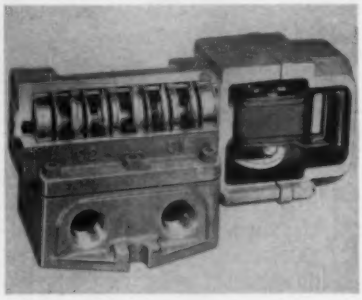


Welding Control

Item 479

Synchronous electronic control is designed for use with small bench welders. It is especially suitable for the resistance welding of items such as electrical parts, optical products, and radio tubes. Model 10E49E-A is available for 115/230 voltage range and is equipped with two plug-in thyratron firing tubes. The thyratron contactor is rated at 12 amp at 50 per cent duty cycle, with a 5-second averaging time. **Robotron Corp.**, 21300 W. Eight Mile Rd., Detroit 19, Mich.

Circle 479 on Page 147



4-Way Air Valve

Item 480

Line of 4-way air control valves is available in single and double-solenoid operated models in 1/4, 3/8, 1/2, and 3/4-inch pipe sizes. A feature of the unit is the controlled-expansion seal which is said to provide positive sealing in all operating ranges from 28 inches vacuum to 150 psig. Valve seats are self cleaning, self aligning, and can easily be replaced. **Air Valves Co.**, 22729 Hoover Rd., Warren, Mich.

Circle 480 on Page 147

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TAPE IN 2
SECONDS
Now splice all 5 to 8 channel paper tapes as well as all 1/2" to 1 1/4" mylar or acetate base magnetic tapes perfectly IN TWO SECONDS with the miracle Presto-Splicer.
Permanent butt-weld or overlap splice lasts under all use conditions because the splice is actually electrically fused! Sticky paste, messy cements and brushes are entirely eliminated. After splicing, tape maintains original condition — data is neither destroyed nor distorted . . . with the new information accurately inserted.
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Circle 710 on Page 147

Use an Inquiry Card

For further information on anything described or advertised in this issue . . . . . .

SEE
Page 147

Midget Muffler

Item 481

Unit is suitable for use as a silencer for noises caused by exhausting air from air operated devices. Muffler is made of polyester foam and is enclosed in an anodized aluminum case. Model M-1 (shown) can be mounted flush to a 1/8 or 1/4-inch exhaust port and protrudes only 3/4-inch. Two other models are suitable for 1/8, 3/8, or 1/4-inch exhaust ports. The muffler is rustproof and can be cleaned with a common solvent. **Mead Specialties Co.**, Dept. MM-46, 4114 N. Knox Ave., Chicago 41, Ill.

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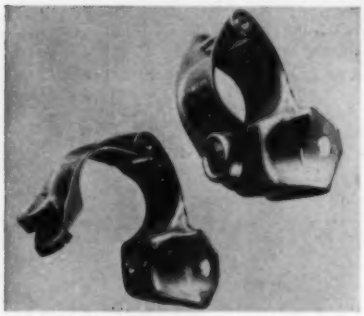

Harness Clamp

Item 482

Device is suitable for holding wire bundles, hose, cables, and conduits. It can be permanently mounted by means of a rivet or a bolt and opened or closed in a quarter turn. Harness clamp is constructed of corrosion-resistant stainless material, has rounded edges to protect against cutting or scratching. Model 7C is available in four sizes: 3/8, 1/2, 5/8, and 3/4 inch. **Camloc Fastener Corp.**, 85 Spring Valley Rd., Paramus, N. J.

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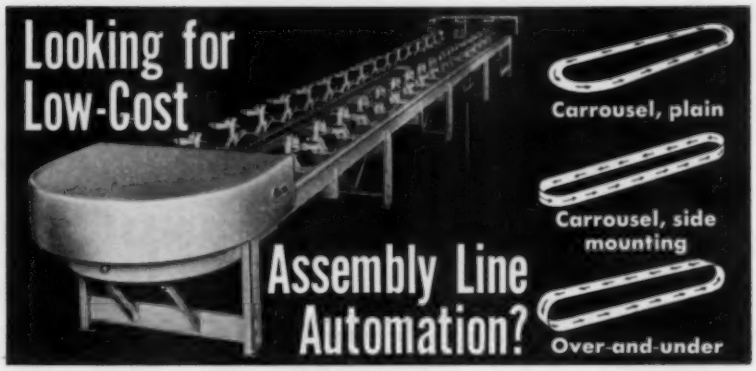

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Conveymatics set and maintain production assembly standards. Carrousel and over-and-under models are available with choice of two drives. Indexing models have infinitely variable dwell or work time and variable indexing lengths and speeds. Continuous drive models feature infinitely variable speed.

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Other New Method Automatic Marker Models

NM Model 700—the cut-off marker for custom OD marking.

NM Model 900—Super automatic roll marker for most types of radial end-face marking.

NM Model 600-E—for end-face marking.

★ There's a New Method automatic marker for most marking and identifying requirements, each designed for a specific need.

★ New Method also manufactures a complete line of manually operated marking devices.

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- *Provides* easy die change
- *Automatic* reset
- *Adjustable* stop for accurate starting position
- *Assures uniform depth* of impressions on parts
- *Drag or scoring* of part prevented by starting pad guards

★ *Write TODAY for* 500-C brochure

NM SINCE 1931

NEW METHOD STEEL STAMPS, INC.
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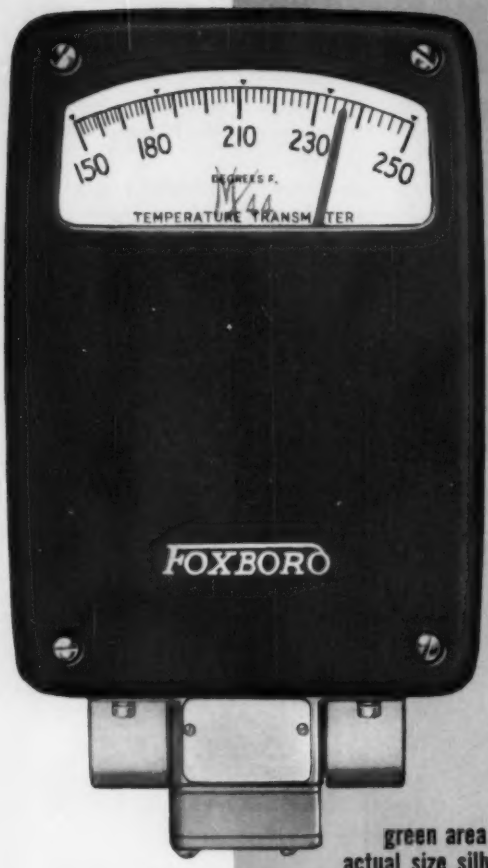
Circle 712 on Page 147

a compact, low-cost

INDICATING TEMPERATURE TRANSMITTER

engineered for fast, sensitive response under roughest field conditions — uses any filled thermal system.



green area is actual size silhouette of the new M/44

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Foxboro M/44 Transmitters are available with any filled thermal system. These classes are suggested for particular range characteristics:

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Good response, good sensitivity, uniform scale. Uses smallest bulb of any filled thermal system.

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Applicable to ranges beyond the limits of other filled systems. Uniform scale. Bulb has long sensitive section; permits useful averaging measurements.

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TEMPERATURE MEASUREMENT AND CONTROL

Circle 713 on Page 147

AUTOMATION abstracts

PROGRESS IN PACKAGING

By C. P. WHITTIER
Packaging Research Div.
Owens-Illinois Glass Co.
Toledo, Ohio

DEPARTMENT OF COMMERCE figures indicate that the packaging industry has been growing at a rate of 5 per cent annually over the past 50 years, resulting in its present value of 10 billion dollars. A vital factor contributing to growth in this industry has been the continual development of automatic packaging equipment and complete packaging lines. Some of these developments will be reviewed, and areas that require further development to permit future industry growth will be explored.

Higher Line Speeds

Packaging line speeds have experienced considerable upward revision in the last 10 years alone, *Fig.* 1. For example, distillery line speeds have gone from 120 to better than 150 containers per minute; soluble coffee from 100 to 280; tablet packaging from 80 to 300 containers per minute; and baby food packaging line speeds have increased from 250 to over 700 jars per minute.

These increases in production rates would be meaningless if efficiency were sacrificed in gaining them. In most instances, however, there have been improvements in over-all line efficiencies through reductions in downtime and container breakage. More efficient maintenance procedures, coupled with availability of better packaging materials and machines, have contributed to increased line efficiencies.

Better Machines

In the field of packaging line components, equipment manufacturers have introduced many new designs and modifications of individual machines. Some typical advances in packaging machine technology will be described.

Uncasers. For many years, there was little progress in the field of casing and uncasing containers simply because the cost of doing the job manually was sufficiently low that mechanical devices were not economical. With the inception of such factors as the Minimum Wage Law and general wage inflation, the cost of transferring containers from carriers to packing lines and back into shipping cases has resulted in making mechanical equipment economical.

Uncasing devices now available either lift the containers from their carriers or permit them to drop out by gravity. Most of the development for this particular operation has taken place since World War II, and manufacturers have continually refined and improved their machines to parallel the operating requirements of their customers. Today, automatic equipment capable of handling 25 to 30 cases per minute is available. The desire not only to reduce labor requirements, but to attain higher packaging speeds, is thus being met.

Cleaners. In the field of cleaning glass containers, there was a period, in the case of single-trip containers at least, where cleaning equipment appeared to lag the general packaging machinery field from the standpoint of top speed. Today, whether cleaning is accomplished by air or water, machinery manufacturers can furnish equipment to meet line speed requirements.

In the air cleaning or rinsing of single-trip contain-

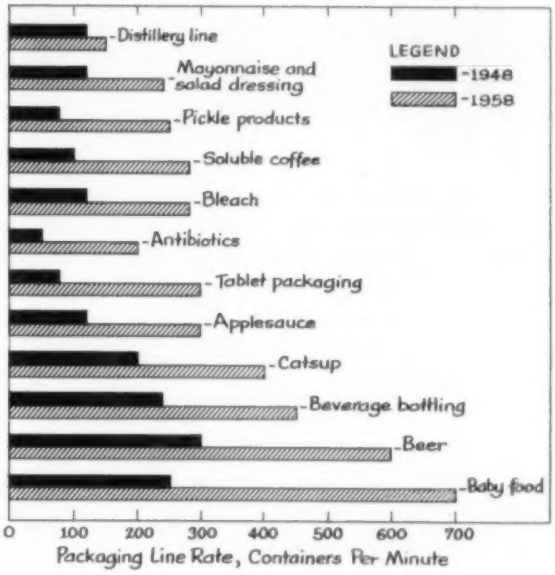

Fig. 1—Chart illustrates gains in production capabilities of packaging lines handling various food, beverage, household, and pharmaceutical products in period 1948-58. Higher line speeds are constantly sought; speeds of 1000 containers per minute are being contemplated for baby food packaging.

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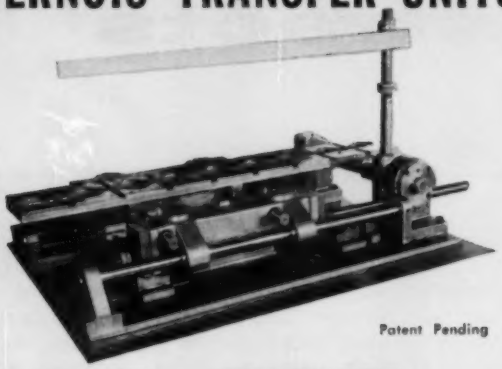
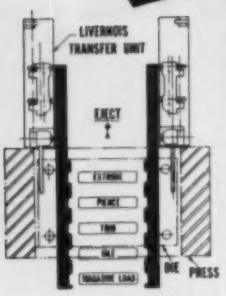


Patent Pending



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- Save on Material
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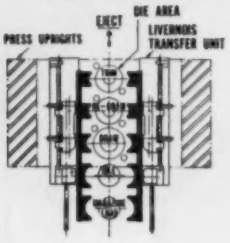

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25200 Trowbridge, Dearborn, Michigan

ers, the machinery manufacturers have solved the problem not only of increasing cleaner speeds, but also handling the great variety of container shapes that the container industry and its customers dream up.

In the case of multitrip containers, equipment has also kept pace with industry needs. While the outward appearance and basic principle of soaker washers has not changed greatly, the manufacturers in this field have done a great deal to make their equipment more foolproof, more efficient from a cleaning and operating standpoint, and less abusive to fragile containers. At the same time, they have built larger and larger units which, because of the sound engineering that has gone into them, are performing better than their smaller counterparts of past years.

Fillers. Today, machines are capable not only of filling by gravity, vacuum, and pressure, but by combinations of these means. This results in higher efficiency, more uniform filling, and greater speed. In addition, provision has been made for longer life and easier maintenance.

In all this activity the needs of certain industries for special filling equipment have not been overlooked. For example, equipment is available for automatically filling such items as pickles and olives; for purging containers with inert gas; and for counting hard and soft tablets in conjunction with filling at ever-increasing speeds.

Cappers. In capping, development of special closures and seals of metal and plastic materials has preceded development of special machinery to apply them to the container. In some instances, seal manufacturers have recognized their responsibilities in developing equipment for applying particular closures, and in so doing have designed capping equipment that can also serve as a power source for the entire filling line, if desired. In the handling of molded and metal screw closures, there has been continuing refinement of equipment to provide better container handling and better control of torque at increasing speeds. Combined operations wherein a fitment is inserted in the mouth of a container followed by the application of the closure are standard in the industry.

Changes in consumer preferences are rapidly met as exemplified by the conversion of cappers that formerly applied side seal closures to the application of screw-type closures. Another example is the change from metal to molded closures for certain packages in the distilling industry, and vice-versa in the bleach industry. Special machines have been evolved to apply closures containing quills or applicators to glass containers.

A unique design feature that is advantageous to both closure manufacturers and packers is the development of capping machine chucks that are not dependent on the knurl count on metal closures. Instead of trying to apply closures by gripping them like gears, today's capping chucks more closely simulate the grip of the human hand.

Labelers. Labeling has long been recognized as one of the greatest sources of lost time in most glass packaging operations. This is due largely to the many variables involved in the application of paper labels to containers that are not subject to precise dimensional control. In spite of the difficulty, remarkable

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progress has been made in the field of labeling. Equipment is keeping pace with the general desire for increased speeds at high efficiency.

Casers. Automatic casers are of several types. In one design, containers are dropped by gravity into the case. In others, bottles are mechanically transferred into the case. After a pattern is gathered, the group of bottles may be lifted into the case inverted above them, or the case may be pushed down on the collected pattern of containers. Each approach has advantages and limitations. The fact remains that efforts being made to improve casing equipment are paying off in reduced casing costs.

Miscellaneous Equipment. Pasteurizer-cooler manufacturers have gone from single deck to triple deck units in order to provide increased production in the same floor area. Equipment is available that will automatically transfer containers from an accumulating table at the end of a processed food packing line to a retort basket, and remove same after processing. Automatic equipment of high efficiency is available for the application of cellulose bands and government stamps to bottles requiring them.

Increased line speeds have resulted in a demand for more automatic means for stacking cases on pallets and removing cases from pallets. A variety of palletizers and depalletizers is now available to the packaging industry.

Future Development Needs

What about the future? Have we reached the boundaries? Have we solved all the problems? Is it simply a question of perfecting present techniques and applying the knowledge we already have? These questions can be answered with one word: *No.* What, then, are some of the things that, when translated into tangible form, will pay off in the future?

1. We have by no means reached the ceiling on packing line speeds for glass containers. This applies whether the operation involves running a single type container or a number of different types of containers over the same packing line. For various reasons, some industries are faced with having to use a basic number of people on a given packing line. The only way these industries can achieve greater production savings is through higher outputs with the same number of people. Because of this, a demand exists for even faster cleaning, filling, capping, labeling, casing, pasteurizing autoclaving, retorting, and cartoning equipment. The baby food industry, for example, is seriously studying operations upwards of 1,000 jars per minute.
2. As line speeds increase, it becomes more essential to eliminate sources of container impact and metal-to-glass or glass-to-glass contact. Continued development is needed in this regard.
3. One of the most serious needs is for the development of fast, foolproof changeover of packaging equipment to permit high outputs from lines that must accommodate a variety of container sizes and shapes. A lot of work is still to be done on packing lines that must be flexible.
4. Equipment for casing and uncasing of glass containers in multitier cases is desired.
5. The returnable bottle industry would be inter-

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90° handle motion produces lock of plunger for push or pull without resetting of handle. Handle is reversible. Plunger guided by two widely separated, hardened steel bushings for accuracy in motion and minimum wear. Built-in deflection provides uniformly tight clamping of parts with normal variation in thickness. Swivel base model provides 90° total change in direction of plunger motion. The air (or oil) operated model, AOP&P-1200, produces approximately 4½ times the clamping force with 85 p.s.i. than the cylinder would alone. Failure of air (or oil) pressure does not permit reverse motion of plunger, thus not affecting clamping force.

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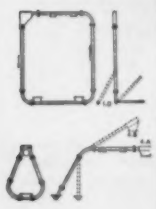
Examples of a few typical circuit plans.



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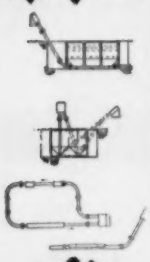

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In British Commonwealth & Europe: Fisher and Ludlow Ltd., Birmingham

Circle 717 on Page 147

ested in a small, compact cleaning unit for multitrip bottles to replace present soaker-washers. Perhaps this can be done through high pressure steam or the use of ultrasonics.

6. There is room for further development in positive torque control on screw capping machinery. Even more challenging would be development of a means of continuous torque measurement on closures after they have been applied. This would insure that packages going to market are sealed sufficiently tight to carry the product through the distribution channels to the consumer, but sufficiently loose for the consumer to readily remove for use.

7. No one has yet come up with the perfect seal for glass containers; one that provides maximum packaging line speed and efficiency, 100 per cent sealing efficiency, and complete consumer acceptance (meaning easy and foolproof removal and replacement).

8. We need means for determining whether a given bottle will label satisfactorily or not. We are constantly searching for devices that will help us reach this objective.

9. The liquor and cosmetic industries would welcome the development of label spotting devices that do not require protruding lugs on the glass containers. Some progress has been made in this regard, but considerably more remains to be accomplished.

10. There is a constant search for methods of lithography on glass and plastic containers. Low cost, suitable printing inks, together with suitable equipment, would answer this need.

11. There is a tangible need for equipment to code containers individually for quality control reasons. While considerable progress has been made, more is needed to permit code changing on the fly (to eliminate shutdowns when changing from batch to batch) and provide codes that do not mar the appearance of cap, label, or container.

12. Any of you that are connected with the food field know that we are still looking for a solution to the problem of aseptic packaging at a cost consistent with the margin of profit in that industry. Drug manufacturers accomplish this objective, but at relatively high cost. They, too, would welcome anything that could be done to decrease aseptic packaging costs.

From a paper entitled "Wishful Thinking Pays Off" presented at the 20th Annual Forum of the Packaging Institute, Chicago, Oct. 1958.

HIGHWAY DESIGN AUTOMATION

By JOSEPH M. CAHN
Benson-Lehner Corp.
Los Angeles, Calif.

IN RECENT YEARS there has occurred what amounts to a complete transfiguration in the time-honored methodology of highway design. This has come about as a result of the application of a number of advanced techniques from other fields. The story of what has been done has interest for anyone concerned with electronic applications to automation.

The first step in the new method of highway design

is to visit the site. The main tool at this point is aerial photography. Techniques developed prior to and during World War II make this far different from qualitative picture taking. It is quite possible through photogrammetry to produce accurate surveys from photographs. The first aerial survey is of an exploratory nature and may cover a strip between road terminals perhaps several miles wide. The photographs are taken in overlapping pairs to permit stereoscopic examination of the terrain. It is possible by use of commonly available stereoplotters to measure the elevation at selected points on this preliminary survey to an accuracy of ten feet. It is possible to do preliminary surveys of several alternate routings within the photograph band without leaving the office. A visit to the site is necessary to confirm the choice by checking ground conditions, subsurface conditions, rock outcroppings, etc., even though their existence may have been indicated on the photos. The route at this point is still only approximate. Another set of photographs is prepared from a lower altitude, permitting a finer elevation resolution; accuracy to a fraction of a foot is now possible.

On these photographs the proposed road centerline may be laid out for a number of alternate routes. Restraining factors are the minimum allowable radius of curvature, maximum desired gradient, and the terrain contours. A detailed survey is now made of the cross-sectional elevations along these routes, using the stereoplotting machine in conjunction with a semi-automatic digital readout. A stereoplotter uses the differential parallax of points in two overlapping photographs to establish relative elevations.

Let us examine this process in more detail. By means of the overlapping photographs, two views exist of every area, taken from different points. The relative positions of objects in the two photographs is a function of their parallax, i.e., their apparent motion on the ground relative to the observer. The closer to the observer, the less motion is apparent.

Three-Dimensional Model

In practice, the two photographs are projected onto a three-dimensional model by using two projectors separated in the direction of flight of the aircraft. To make it possible for the observer to "see" the three-dimensional model, the light from the two projectors is made separable by using blue light for one, red for the other, and having the operator wear glasses, one lens of which is red and the other, blue.

The observer manipulates an illuminated spot until it appears to rest on the ground in the model, at which time its elevation in the model is proportional to the original ground point elevation. The elevation of this lighted spot, and its location in the model, are instrumented either with potentiometers or precision synchros. In some models only the distance along an accessory bar is instrumented in the horizontal plane. This bar is then placed perpendicular to the highway centerline at each station, and elevations measured along it.

The availability of this data in an instrumented form

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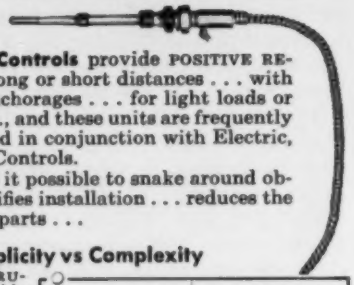

Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electric, Hydraulic and Air Controls.

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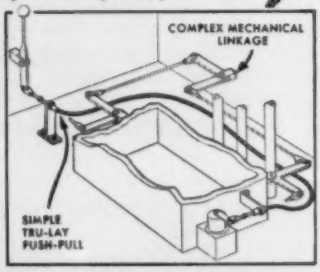
Simplicity vs Complexity

Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased backlash, lost accuracy and vibration rattles.



Positive Remote-Action and Flexibility, together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

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makes possible the use of equipment such as a record reader which converts the data directly into digital form on punched cards or punched paper tape. It is a simple matter to correct this raw data for scale factor and reference elevation so that the computer media is entered with the data directly in feet.

The stereoplotter operator uses his machine to produce a series of cross sections in the same form as those previously turned out by field surveying crews. To each such cross section is added by manual keypunch or by the digital computer, the highway templet which is actually the designed cross section of the new road. The centerline elevation of the templet has been determined as in the old method by consideration of gradients, etc. The resultant set of points defines a complete highway cross section. This information is entered into a digital computer which is programmed to compute the cut and fill areas of each cross section and between cross sections. Some programs have even been devised to yield earth-work costs directly.

This process may be repeated as often as necessary to include alternate routes, redesigns, determination of over and under grade transfers, etc. The cost of these computations may be cheaper than before by a factor of from ten to twenty times. Routes can be laid out and changed and rechanged in a matter of hours, thus permitting a quick and cheap check on the designer's judgment.

Originally, cross section plots were required prior to earth-work computation. Now, since they are no longer used for this purpose, they must be plotted from the computer tabulation. Plotting machines have been designed to automatically generate straight line plots directly from the computer output, either punched cards or punched paper tape. Such a machine may operate from 3 to 20 times as fast as manual plotting, the variation depending on the complexity of the plots.

Advantages

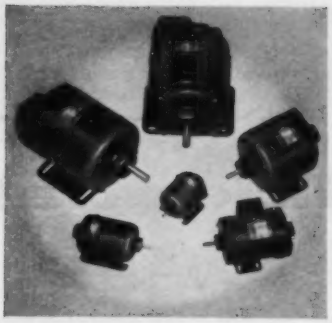
The impact of this change on the design philosophy of highway engineers cannot be overestimated. Conservative sources estimate that the new methods should, by virtue of the superior designs generated, save up to 20 per cent in highway construction costs. This might be as much as $20 billion over the next 10 years.

Due to the ease and the low cost of obtaining highway design data using the new methods, highway designers are likely to enter the picture much earlier than before. It is far easier to get tentative cost estimates and solve routing problems. It is not unlikely that, in the future, prior knowledge in these areas will greatly affect political commitments and reduce costs by yielding, in advance of commitment, comparative data between alternate ways to solve a particular traffic problem.

The highway design techniques described have come about in perhaps three to five years. Besides the enormous benefit to the highway industry, this new application for electronics has created a market of perhaps $30 million for electronic equipment.

From a paper entitled "Automation In Highway Design" presented at the AIEE-IRE-ASME Automatic Techniques Conference, Detroit, April 1958.

Circle 719 on Page 147



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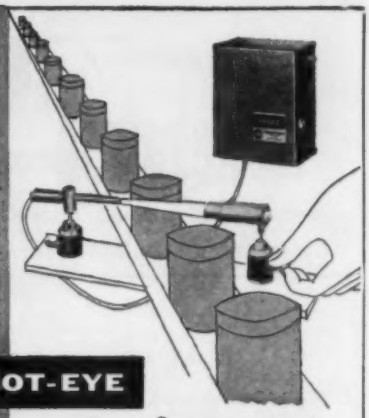

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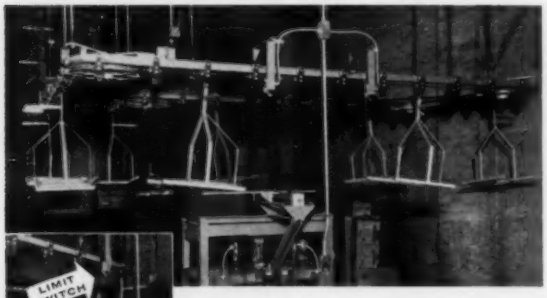

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Circle 721 on Page 147

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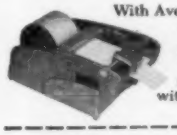

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Circle 723 on Page 147

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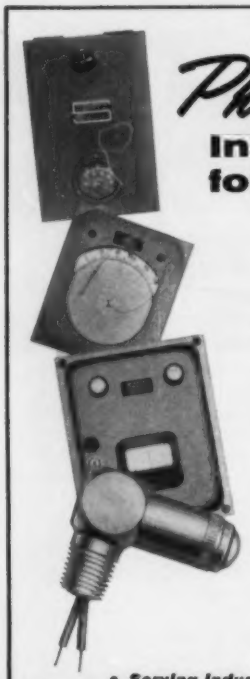
Circle 724 on Page 147



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ELECTRONIC INSTRUMENTS and CONTROLS for INDUSTRY

Circle 725 on Page 147

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Readers with problems concerning systems, equipment, or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solution suggestions are invited to submit them and should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

CASE 1732-P

TAPE PUNCHES AND READERS

. . . Could you give me the names of some companies that make devices for cutting punched tape and also playback mechanism. My interest is in finding a company that makes this equipment that can be attached to a separate control programmer. Any information you can give me will be appreciated. . .

Engineer

CASE 1731-P

FEEDING GUN BELT LINKS

. . . I want to know if you have any data on the latest methods for unscrambling, aligning, and feeding machine gun belt links into assembly machines. . .

Lead Foreman

SUGGESTIONS FOR 1621-P (DEC. 1958)

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Circle 726 on Page 147

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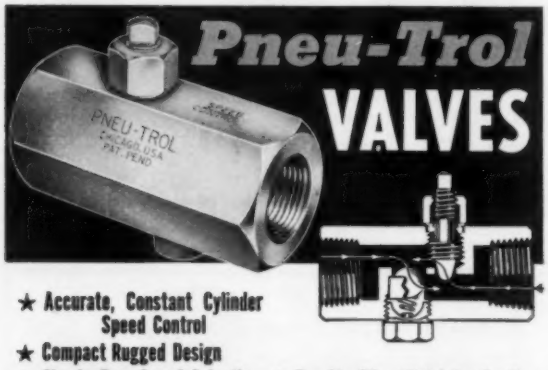

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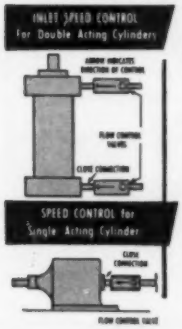

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Circle 727 on Page 147

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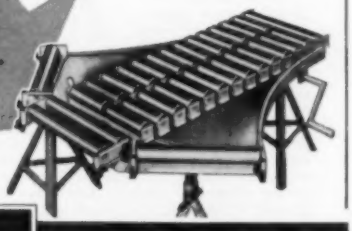

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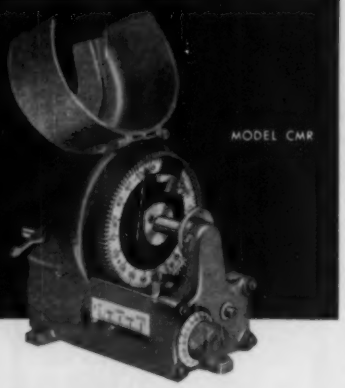

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Consultant report includes three main sections; An introduction to leasing and leasebacks, real estate leasebacks, and equipment leasing. The first section discusses claimed advantages and financing aspects; the second, transactions in which a sale is subject to the condition that the seller simultaneously lease the property from the buyer as soon as title passes. The third section discusses advantages, characteristics, and legal factors in equipment leasing, including suggestions for lessors and lessees.

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AUTOMATION patents

Copies of patents are available at 25 cents each from the Commissioner of Patents, Washington 25, D. C.

SHEET-SAMPLING MECHANISM

After a pair of slitting blades has pierced a traveling sheet, one of the blades moves laterally away from and back to the other blade to cut sample strip. An adhesive-coated roller then picks up the sample from between the slits. Patent 2,837,155 by Lester B. Cundiff and William M. Watts, assigned to American Viscose Corp.

INTERMITTENT FEED MECHANISM

Rotating feed member is electrically coupled to a gear which is driven by a reciprocating gear segment. Operation is synchronized so that the coupling device is energized on forward movement of gear segment and is released on backward movement. Patent 2,839,138 by Kurt E. Wilhelm, assigned to United States Rubber Co.

APPARATUS FOR TRANSFERRING ARTICLES

Articles from a dispenser are deposited on a set of spaced fingers. Unit rotates over an offset scale, and spaced fingers lower between similar fingers forming weighing platform, depositing article on scale platform. Patent 2,839,205 by Max E. Toby and Daniel J. Toby, assigned to Package Enterprises Inc.

APPARATUS FOR TRANSFERRING AND LOADING ANODE BUTTONS ON A CARRIER

Endless conveyor chain intermittently moves anode buttons to a discharge station where a stripper device removes a button from a holder on the conveyor and positions the button in a carrier. A clamping finger automatically holds button as stripping device is retracted. Patent 2,842,252 by John R. Prendergast, assigned to Owens-Illinois Glass Co.

ELECTROMECHANICAL MEMORY OR SYNCHRONIZING SYSTEM

In a continous process line for depositing material on a base material, a pre-process gaging station measures the thickness of the base material and transmits a dc voltage signal to the input of an electromechanical memory device. After material is deposited on the base material, a post-process gaging station initiates a dc voltage signal equivalent to the combined thicknesses of the materials. The memory device delivers its output signal to a subtraction means at the instant of application of the post-process gaging signal, and the subtraction means indicates the thickness of the deposited material. Patent 2,842,851 by Albert M. Dexter Jr., assigned to Pratt & Whitney Co. Inc.

PRINTING DEVICE

Type characters for a printer are located on the periphery of a helix. Type wheel rotates continuously, and impulse means causes desired letter to print. Patent 2,843,243 by Earl E. Masterson, assigned to Sperry Rand Corp.

SORTING AND ORIENTING

Parts, slotted on one end, are fed between two rotating wheels having projections spaced around their perimeters. Depending upon which way the slotted part lies, a projection on one wheel pushes against the head of the part until the slotted end is engaged on projection of the other wheel. As the wheels rotate, the slotted parts ride onto guide rails which cause the parts to disengage from the wheels. Patent 2,843,254 by Gerald L. Vaughan, assigned to Diamond Gardner Corp.

WAFER GAGER

Rectangular wafers are automatically transferred between stations of a gaging unit which first checks the thickness and width of the wafer in one direction, then turns the wafer 90 degrees and checks the width in the other direction. Wafers are rejected at respective stations if they are too thick, too wide, or too narrow. Patent 2,843,263 by Robert L. Henry Jr., assigned to the United States of America.

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MONDAY . . . . . SESSION I & II . . . . . MARCH 23, 1959

Developing Automation for Flexibility of Output

A PANEL—Manufacturing Engineering—IBM, Endicott, N. Y.
1. ORGANIZATION—**KEITH BENNETT,** Project Engr., Test Equipment Engineering
2. STUDY OF OPERATIONS—**GEORGE PHILLIP,** Project Engr., Mfg. Research
3. DEVELOPING THE HARDWARE—**ALFRED JOHNSON,** Project Engr., Mfg. Research
4. DATA PROCESSING—**WILLIAM ANDRUS,** Manager of Applied Computation
5. ECONOMICS—**RICHARD SEILER,** Technical Ass't to Ass't Mfg. Engr.

Buffet Lunch — **Automation on the Farm**
WILLIAM ALDEN, President, Automation Management Inc.

Industrial Engineering's Role in Automation of Operations
H. H. YOUNG, Assoc. Prof., Dept of Industrial Engineering, Purdue University

Cost Analysis and Machine Replacement
ROBERT A. LOWE, Managing Partner, R. A. Lowe & Co.

TUESDAY . . . . . SESSION III & IV . . . . . MARCH 24, 1959

Manufacturing Engineering and Machine Procurement
ARMIN FRANK, Manager-Manufacturing, Vacuum Cleaner Dept., General Electric Co.

Assembling Complex Devices
GEORGE WEISER, Chief Process Engineer, Delco-Remy Div., General Motors Corp.

Buffet Lunch — **Pioneering in Automation**
E. W. LEHMANN, Prof. Emeritus, Agricultural Engineering, University of Illinois

Handling as the Key to Automation for the Small Company
JAMES R. SEBASTIAN, President, The Rapids-Standard Co. Inc.

Handling Products for Distribution
ALLAN HARVEY, President, Dasol Corp.

Banquet — **Guaranteed Annual Automation**
LEON GREENBERG, Chief, Div. of Productivity, U. S. Dept. of Labor

WEDNESDAY . . . . SESSION V & VI . . . . MARCH 25, 1959

Modern Developments in Control
DR. JOSEPH F. MANILDI, General Manager, Thompson-Ramo-Wooldridge Products Co.

Numerical Control of Production Machines
W. E. BRAINARD, Chief Engineer, Servo Machine Tool Div., Kearney & Trecker Corp.

Buffet Lunch — **Automating the Horses**
O. C. LEVY, Vice President, American Totalisator Co., Div. of Universal Control Inc.

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Roller Chain Data

Acme Chain Corp., Holyoke, Mass.—98 *page catalog* — Detailed information is given on line of roller chains, sprockets, and conveyor chain attachments. Advantages of roller chain drives are given, as are suggestions for selecting the proper drive. Correct lubrication for slow, medium, and high speed drives is explained. Sketches show the recommended drive positions and the different methods of chain adjustment. Tables list chain lengths and horsepower capacities.

Circle 483 on Page 147

Digital Demand Recorder

Fischer & Porter Co., 828 Jacksonville Rd., Hatboro, Pa. — 16 *page booklet* — Punched tape digital demand recorder, an impulse counting and recording device applicable in production control and counting operations, is described in Catalog 35A1000. Details are given on the operation of the input and pulse memory mechanism, the interval timer mechanism, and the punching and reset mechanism. Also explained is the coding system and tape design, and a typical punched card format is presented.

Circle 484 on Page 147

Hydraulic Control Panels

Petch Mfg. Co., 463 York St., Detroit 2, Mich.—8 *page bulletin*—Data on fabricating hydraulic panels from standard components are given in Bulletin H-58. The bulletin explains how the pressure, return, and drain line manifolds are drilled vertically into the blocks and form a continuous passage from block to block. Sketches show panel accessories and the different components that make up a block panel.

Circle 485 on Page 147

Level Indicator

Instruments Inc., P.O. Box 556, Tulsa, Okla.—4 *page pamphlet*—A level indicator, designated Radionic, is the subject of Bulletin 558. Using nuclear radiation, the instrument is designed to determine the liquid or solid level within a closed vessel. Principle of operation is explained and applications noted.

Circle 486 on Page 147

Square Head Cylinders

Tomkins-Johnson Co., Jackson, Mich. —6 *page pamphlet*—Interchangeable cylinders, designed for 200 psi air or 1000 psi oil pressure, are outlined in Bulletin SQ-10-58. A cutaway photo shows the construction features and line drawings show the different mounting arrangements. Mounting dimensions are also listed for the cylinders which are available in bore diameters from 1½ through 8 inches.

Circle 487 on Page 147

Fluid Power Equipment

Oilgear Co., 1571A W. Pierce St., Milwaukee 4, Wis.—12 *page booklet*—Data are given in Bulletin 10051-G on line of industrial fluid power equipment. Equipment described includes variable delivery one and two-way pumps with numerous controls; constant delivery pumps; automatic feed pumps; variable speed transmissions; and standard 2000 psi and heavy-duty 3500 psi cylinders (2 to 8-inch bore size). The types of valves covered include servo valves for electrohydraulic systems, directional control, relief, foot, surge, pilot, combination, and differential valves.

Circle 488 on Page 147

Air Motors

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.—16 *page booklet*—Air motors which cover a power range from 0.3 to 24 hp, with speeds running from 50 to 2580 rpm are outlined in Bulletin 5072A. Both multivane and piston motors are described. Dimensional drawings are given and a cutaway photo shows the construction features. Notes are also given on how the motors can be adapted for remote control.

Circle 489 on Page 147

Infrared Food Processing

Fostoria Pressed Steel Corp., Fostoria, Ohio—8 *page bulletin*—Infrared heating and its use in food processing is the subject of Bulletin 58-121. The use of electric infrared in production cooking, drying, and baking operations is outlined. Characteristics of the various infrared heating elements used in the equipment are discussed. Illustrations show the various applications.

Circle 490 on Page 147

Double Spindle Disc Grinders

Mattison Machine Works, Rockford, Ill. —12 *page booklet*—Double spindle disc grinders, ranging from 10 to 30-inch disc wheel capacity, are described in Bulletin 647-2RM. Applications for each of the six different models in the line are given. Illustrations show the different types of feed mechanisms available.

Circle 491 on Page 147

Oscillating Conveyors

Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.—22 *page booklet*—Three oscillating conveyors, which can handle material from 25 to 350 tph, are described in Book 2744. Illustrations show the oscillating action and sketches display pertinent dimensions. Notes are given on selecting the proper type of conveyor. Data are also included on trough widths, depths, section lengths, and accessories.

Circle 492 on Page 147

Strain Gage Measuring Units

Electronics & Instrumentation Div., Baldwin-Lima-Hamilton Corp., 42 Fourth Ave., Waltham, Mass.—16 *page booklet*—Industrial techniques for measuring force, weight, and pressure are compared in booklet titled "Modern Force Measurement." The principle of bonded strain gages and their use in force measurement devices is outlined. Characteristics of the various devices are listed to help choose the proper system, and a discussion on the importance of an integrated force measurement system is given. Illustrations show many typical systems.

Circle 493 on Page 147

High Speed Flaring Machine

Automation Associates Inc., 1444 E. 11 Mile Rd., Madison Hts., Mich.—4 *page pamphlet*—Model C-2, a high-speed tube flaring machine designed to produce an accurate double-walled flare on the ends of ⅛ to ⅝-inch tubing, is the subject of Bulletin 581. Operating principle of the machine, safety features, and tool change-over are covered. Data are also given on an air operated parts loader and unloader which can be attached to Model C-2.

Circle 494 on Page 147

Relief Valves

McDonnell & Miller Inc., 3500 N. Spaulding Ave., Chicago 18, Ill.—4 *page pamphlet*—Safety relief valves for hot water space heating boilers are outlined in Bulletin P-33. The bulletin discusses the conditions the valves must meet in hot water heating services and both the normal operation and emergency operation of the valve is explained.

Circle 495 on Page 147

Excitation System

Electric Regulator Corp., Pearl St., Norwalk, Conn.—4 *page pamphlet*—A dual-mode excitation system for ac generator control is the subject of Bulletin 8.010. The principle of operation is explained,

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aided by schematic diagrams. Wiring diagrams are also given and sketches show test results. Data are included for installing the excitation system.

Circle 496 on Page 147

Hydraulic Presses

Hannifin Co., Dept. 142, 501 *S. Wolf Rd., Des Plaines, Ill.—24 page catalog*—Data are furnished in Bulletin 130G, on line of open gap and column type high-speed hydraulic presses. The presses, which range in capacity from 1 to 150 tons, can be used for forcing, straightening, trimming, molding, bending, and press-fit assembly operations. The different types of control equipment which can be used on the presses are described. A section of the booklet contains engineering formulas and suggestions for selecting the proper press for a specific application.

Circle 497 on Page 147

Process Chromatography

Scientific & Process Instruments Div., Beckman Instruments Inc., 2500 *Fullerton Rd., Fullerton, Calif.—2 page pamphlet*—A multistream, multicomponent controller for chromatographic analyses is described in Bulletin GC-4117. Instrument features, such as automatic operation, accuracy, and analysis speed, are explained. Mounting dimensions are listed to aid in planning for installation in control panels.

Circle 498 on Page 147

Power Supplies

Electronic Measurements Co. Inc., Eatontown, N. J.—8 page bulletin—Bulletin 765A, entitled "A New Approach to Practical Control," covers line of programmable power packs. The voltage regulating circuit is described and performance characteristics noted. Sketches show the instrument's versatility in use and graphs display the output voltage that is available at reduced currents.

Circle 499 on Page 147

Flow-Control Servo Valves

Moog Valve Co. Inc., Proner Airport, East Aurora, N. Y.—6 page pamphlet—Data are contained in Catalog 220 on line of flow-control servo valves with maximum flow rates to 10 gpm at 1000 psi valve drop with operating supply pressures from 500-4500 psi. Operating principle is explained and a cutaway photo shows the construction features. Definitions of servo valve terms are also given. Performance charts show curves for normal flow gain tolerance, load flow-pressure characteristics, typical frequency response and tolerance, and nominal coil characteristics.

Circle 500 on Page 147

Heavy Duty Limit Switches

Micro Switch, Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.—16 page booklet—Line of heavy duty limit switches is described in Catalog 84. Data are given on three types of switches—Series 200LS, a plug-in type; Series LS, a miniature, compact type; and Series ML, for rugged operations. Contact arrangements are listed and sketches show mounting dimensions. Illustrations show several actuator designs in each switch type.

Circle 501 on Page 147

Pneumatic Conveyor Systems

Robinson Air-Activated Conveyor Systems, Div., Morse Boulger Destructor Co., 80-W *Fifth Ave., New York* 11, *N. Y.—4 page pamphlet*—Pneumatic conveying systems for handling fine-granular and dry-pulverized chemicals, minerals, plastics, grains, and food products in bulk are outlined in Bulletin 401. Drawings show how the air flow method injects the material into the conveying line and a diagram shows a typical arrangement of the basic elements of a pneumatic system.

Circle 502 on Page 147

Rotary Marking Machines

Acromark Co., 9-13 *Morrell St., Elizabeth* 4, *N. J.—9 page bulletin*—Automatic and semiautomatic rotary marking machines are described and illustrated in Catalog 9. The machines are suitable for marking metal products and parts including steel and cast iron. Additional photos show the different types of feeds and fixtures available.

Circle 503 on Page 147

Automatic Custody Transfer

Pottermeter Co., Div., Potter Aeronautical Corp., U. S. Route 22, *Union, N. J.—4 page chart*—"Automatic Custody Transfer with Pottermeter" is the subject of chart. Schematic drawings show the principle of operation of the remote readout and control system which provides continuous flow measurement at any flow rate. Diagram compares four different kinds of automatic fuel measurement systems for the petroleum industry.

Circle 504 on Page 147

Digital Clock

Panellit Inc., 7401 *N. Hamlin Ave., Skokie, Ill.—2 page pamphlet*—Bulletin 8-41 contains technical details on digital clock (Model 281) which has 3 independent outputs, each resolved to 1 second. Clock is applicable on data handling equipment and computers, or wherever an electrical readout of time is required. Each of the 3 independent outputs from this digital clock may be presented serially or in parallel.

Circle 505 on Page 147

Printing on Corrugated Boxes

Hinde & Dauch, Sandusky, Ohio—28 page handbook—Booklet 8, titled "How To Use Printing On Corrugated," covers various phases of printing. Notes are given on selecting the basic box design, selecting the type of corrugated board, the background, copy, illustrations, number of colors, and choice of typography. Data are included on how to achieve better identification, how to build a brand image, how to plan family packaging, and point-of-sale displays.

Circle 506 on Page 147

Magnetic Rubber

Denman Rubber Mfg. Co., Warren, Ohio—4 page pamphlet—A flexible, magnetic material which has a resistance to oils and acids is described in Bulletin 58. The basic characteristics and properties of the material are explained and its applications in molded or sheet form are given. Various illustrations show the material's versatility.

Circle 507 on Page 147

Hydraulic Weighing System

A. H. Emery Co., New Canaan, Conn. —16 page booklet—Packaged hydraulic weighing systems developed for less than 1000 lb range, are described in Bulletin 582. Action of the hydraulic load cell, which is the heart of the system, is explained, aided by schematic drawings. The basic types of cells are discussed and suggestions are given for selecting the proper system for a specific application. Data are also included on equipment that can be used in combination with the weighing system.

Circle 508 on Page 147

Industrial Control Devices

Euclid Electric & Mfg. Co., Madison, Ohio—8 page bulletin—Data on line of industrial control devices are contained in Bulletin 958. Items in the line include pushbutton stations, speed-responsive switches, resistors, contactors, and relays. Photos also show some of the assembled controllers available.

Circle 509 on Page 147

Barrel Finishing Machine

Techline, Div., Wheelabrator Corp., 2400 *Avenue "V" Vicksburg, Mich.—4 page pamphlet*—Model 30, a barrel finishing machine suitable for deburring, finishing, descaling, and burnishing operations, is described in Bulletin 200. Safety features and material specifications are noted. Other features such as special door cams, leg supports, and lined cylinders are also mentioned.

Circle 510 on Page 147

Pulse Magnetic Amplifiers

Semiconductor Div., Hoffman Electronics Corp., 920 *Pitner Ave., Evanston, Ill. —8 page bulletin*—Booklet is divided into two sections. One section discusses the design of magnetic amplifiers using silicon

diodes and magnetic cores. Operation of the amplifier is explained and schematic drawings show: A typical switching signal, power oscillator and output waveshapes, and a basic complementing pulse magnetic amplifier. The second section covers pulse magnetic amplifiers using logic circuits. Here, too, numerous schematic drawings show the different logic operations possible.

Circle 511 on Page 147

Read & Record Heads

Librascope Inc., 40 E. Verdugo Ave., Burbank, Calif.—4 page pamphlet—Data are contained in Bulletin E200 on read and record heads which are designed for magnetic drums and suitable for use in data handling and computer memory systems. Illustrations show the different mounting methods and charts list performance characteristics. Notes are also given on the various styles of magnetic drums.

Circle 512 on Page 147

Roller & Wheel Conveyors

Conveyor Systems Inc., 6451 Main St., Morton Grove, Ill.—6 page bulletin—Data on Flip-out roller conveyors and wheel conveyors are contained in Bulletin MHC58. The advantages of wheel conveyors and the advantages of Flip-out conveyors are discussed with suggestions given for the best use of each type. Illustrative examples of different applications are also included.

Circle 513 on Page 147

Strip-Chart Recorder

Instrument Div., Varian Associates, 611 Hansen Way, Palo Alto, Calif.—4 page pamphlet—A null-balance potentiometer type, strip-chart recorder is described in Data Sheet G-11A. A schematic diagram explains the operating principle and a chart lists the different types of input chassis available. Optional features and accessories are also covered.

Circle 514 on Page 147

High-Temperature Materials

Haynes Stellite Co., Div., Union Carbide Corp., Kokomo, Ind.—8 page bulletin—Silicon nitride, a material designed to operate up to and over 3000 F in certain atmospheres, is the subject of Bulletin F-30114. Typical properties of silicon nitride are discussed and test results are given which show the resistance of this material to the attack of molten metals. Also covered are various applications of the material, such as in thermocouple protection tubes.

Circle 515 on Page 147

Tube and Pipe Products

Weatherhead Co., 2310 Dwenger Ave., Fort Wayne, Ind.—8 page bulletin—Data are contained in Catalog C-101 on tube working tools such as swaging tools, tube

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419	459	499	539	579	619	659	699	739	779	819
420	460	500	540	580	620	660	700	740	780	820
421	461	501	541	581	621	661	701	741	781	821
422	462	502	542	582	622	662	702	742	782	822
423	463	503	543	583	623	663	703	743	783	823
424	464	504	544	584	624	664	704	744	784	824
425	465	505	545	585	625	665	705	745	785	825
426	466	506	546	586	626	666	706	746	786	826
427	467	507	547	587	627	667	707	747	787	827
428	468	508	548	588	628	668	708	748	788	828
429	469	509	549	589	629	669	709	749	789	829
430	470	510	550	590	630	670	710	750	790	830
431	471	511	551	591	631	671	711	751	791	831
432	472	512	552	592	632	672	712	752	792	832
433	473	513	553	593	633	673	713	753	793	833
434	474	514	554	594	634	674	714	754	794	834
435	475	515	555	595	635	675	715	755	795	835
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437	477	517	557	597	637	677	717	757	797	837
438	478	518	558	598	638	678	718	758	798	838
439	479	519	559	599	639	679	719	759	799	839
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406	446	486	526	566	606	646	686	726	766	806
407	447	487	527	567	607	647	687	727	767	807
408	448	488	528	568	608	648	688	728	768	808
409	449	489	529	569	609	649	689	729	769	809
410	450	490	530	570	610	650	690	730	770	810
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Thread Rolling

Landis Machine
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Magnetic Tape

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"Precision Reels fo
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Control Device

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Digital Logging

Datex Corp., 1307
rovia, Calif.—4 page
matic digital logging
signed to provide a

new catalogs..... latest literature

rs, tube bending springs, and swaged assemblies. Available tube fittings described and sketches show the dif- t designs available. Notes are also n on industrial hose types.

Circle 516 on Page 147

ead Rolling Attachments

ndis Machine Co., Waynesboro, Pa. page catalog—Repair parts for thread ng attachments are listed in Bulletin -2. Dimension charts of each diame- nd pitch, maximum bar and hex bar are given, as are penetration rates olt, straight pipe, and taper pipe ap- tions for five sizes of attachments. ications of the attachments to the dif- t sizes of automatic screw machines turret lathes are noted and line draw- show the required modifications nec- y to the machine or attachment on applications. Data are included on ng positions and cross slide travel.

Circle 517 on Page 147

gnetic Tape Reels

innesota Mining & Mfg. Co., Dept. 76, 900 Bush St., St. Paul 6, Minn.— age pamphlet—Bulletin 36, entitled cision Reels for Instrumentation Re- ing," discusses reels for wider, thin- base tapes. Features of the precision reels are noted and the booklet re- s how a new reel design overcomes problems encountered in the instru- tation field.

Circle 518 on Page 147

trol Devices

ectro Precision Corp., Arkadelphia, —4 page pamphlet—Data are given line of control devices of "building k" design. Some of the units are: Out- amplifiers, automatic gain control, actuators, decade counter, variable h pulse generator, gate control, and panel assembly. Block diagrams show w of the combinations which can be icated for either analog or digital, combination analog-digital computa- and control systems.

Circle 519 on Page 147

apping Equipment

me Steel Co., 135th St. & Perry Ave., ago 27, Ill.—8 page bulletin—Equip- t, described in Bulletin 276-7-58, feeds strapping around large packages at rate of 4½ fps. Data are given on the rent models that comprise the strap assembly. Notes are included on op- al accessories which can be used with equipment.

Circle 520 on Page 147

ital Logging System

atex Corp., 1307 S. Myrtle Ave., Mon- a, Calif.—4 page pamphlet—An auto- c digital logging system which is de- ed to provide a digitized output from potentiometer recorders or shaft inputs is described. Operation of the system is explained and installation methods are noted. The system provides automatic or on demand digital recording on adding machine tape from many types of commercial chart recorders or from a shaft output.

Circle 521 on Page 147

Control Valves

Beckett-Harcum Co., 985 W. Locust St., Wilmington, Ohio—8 page bulletin—Line of air and hydraulic control valves in sizes from ⅛ to 1-inch are described. Design of the basic valves is explained, as are the styles which are devised from the basic valve. Charts list specifications and dimensions for single and double solenoid valves, and manual, mechanical, and pilot-operated valves.

Circle 522 on Page 147

Hydraulic Cylinders

Milwaukee Cylinder Co., Div., L & M Machine Co., 5757 S. Pennsylvania Ave., Cudahy 7, Wis.—8 page bulletin—Line of hydraulic cylinders in sizes from 1½ to 12 inches, for 2000 to 3000 psi, is outlined in Bulletin H-100. Engineering data on piping, cushions, fluids, and piston rods are given. Sketches show piston rod end styles and different mounting arrangements.

Circle 523 on Page 147

Hermetically Sealed Relays

General Electric Co., Schenectady 5, N. Y.—24 page catalog—Data on micro-miniature, sub-miniature, miniature, and high-speed relays are contained in Bulletin GEA-6628. Charts list mounting forms without brackets or studs, with side-bracket mounting, side-stud mounting, etc. Coil data and wiring diagrams are given. Also included are prices and ordering instructions.

Circle 524 on Page 147

Draft Gages

Hays Corp., Michigan City, Ind.—19 page booklet—Bulletin 58-S201, entitled "Draft-what-where-how-why," is divided into four sections. These sections cover what draft is, how it is measured, and where to measure draft and pressure in a modern steam plant. Data are also given on how to select the proper draft gage to suit a particular requirement, and how to connect and install draft gages.

Circle 525 on Page 147

Vibrating Conveyors

Carrier Conveyor Corp., 211 N. Jackson St., Louisville, Ky.—4 page pamphlet—Details on three high-temperature vibrating conveyors are given in Data Sheet 700-HT-9. Vibrating principle is explained, as is the controlled trough expansion and double trough design. Also included are notes on maintenance.

Circle 526 on Page 147

Plating & Metal Finishing

Partlow Corp., New Hartford, N. Y.—4 page pamphlet—Pneumatic controls, which are suitable for controlling the temperatures of plating operations, are described in Bulletin 1086. The units will operate on 3-15 psi air pressure. The valve operation of the mercury-actuated instruments is explained. Data are also given on indicating, nonindicating, and recording electrical controls.

Circle 527 on Page 147

Data Processing System

Remington Rand, Div., Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y.—6 page pamphlet—Univac II, containing a new high-speed magnetic-core memory system, is the subject of Booklet U1395. The computer memory system provides instantaneous access to 24,000 alphabetic or numeric characters. The Univac II can read and record information at a pulse density of 250 characters per recording inch on magnetic tape. Data are given on the central computer equipment and on the input and output auxiliaries.

Circle 528 on Page 147

Pressure Transducers

Gulton Instrumentation Div., Gulton Industries Inc., 212 Durham Ave., Metuchen, N. J.—4 page pamphlet—Strain gage pressure transducers, which can be used with galvanometer and tape recording systems, telemetry and analog-to-digital data handling systems, are outlined in Bulletin PSG-1. Operation of the instruments is explained. Circuit diagrams and a sketch of a typical installation are also given.

Circle 529 on Page 147

Tubeless Photoelectric Controls

Autotron Inc., Box 722RR, Danville, Ill. —4 page pamphlet—Tubeless photoelectric control devices with a Cad Cell sensing element are outlined in Catalog 58-1. The controls can be supplied with transistors or magnetic amplifiers, and suitable light sources (either remote or self-contained sensing heads) which are described.

Circle 530 on Page 147

Stamping Presses

Alpha Press & Machine Inc., 9281 Freeland Ave., Detroit 28, Mich.—12 page booklet—Data are given in Catalog 855P on line of high-speed, 2-point, underdrive stamping presses. Construction of the unit is described and the action of the feed rolls and snap cutter are explained. A chart lists press speeds and other data for the units which have capacities ranging from 50 to 300 tons.

Circle 531 on Page 147

Miniature Dial Timer

Automatic Timing & Controls Inc., Dept. 202, King of Prussia, Pa.—4 page pamphlet—Data are contained in Bulletin N-80 on miniature cycle dial timer which controls two independently adjusted load circuits for *On-Off* cycling. Principle of operation is described and machine and process control applications are noted. Wiring diagrams are also included, as are electrical ratings, mounting dimensions, and a table of standard dials.

Circle 532 on Page 147

Sam: this may solve Transmission problems. Suggest you investigate. C.K.

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Joe: these people have a lot of machines in Detroit look them over and let me have your reaction – Sam

Circle 652 on Page 147

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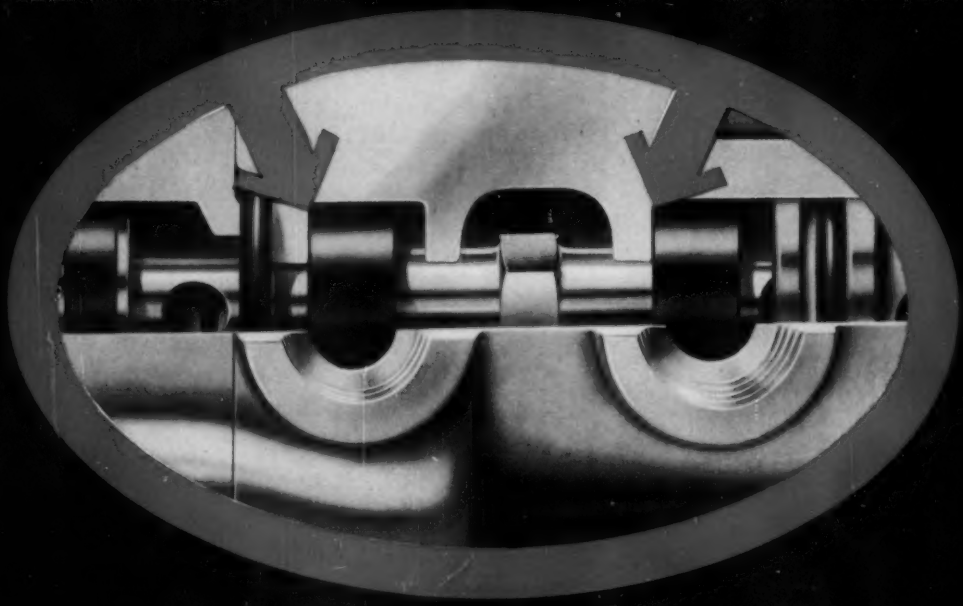

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Dead tight shut-off—even on air—is assured in these four-way valves through poppet seals, and by a unique combination of metal to metal and resilient seating. No lapping, grinding or close adjustments are necessary — no binding or leaking can occur. Short piston disc assembly travel, basic design simplicity eliminate maintenance problems.

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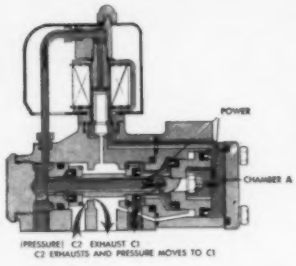
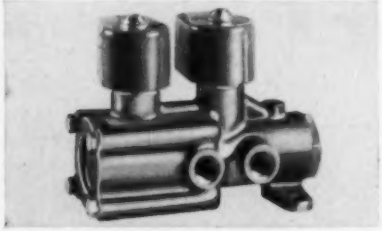
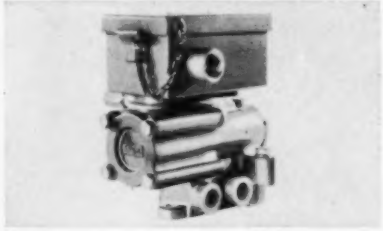


Operation: ASCO Single Solenoid 4-way Valves are power-driven in both directions by line pressure. When the solenoid is de-energized, line pressure applied to the top of the piston core forces it off the seat, eliminating possible sticking due to residual magnetism. Line pressure is applied to Chamber A, moving the piston-disc assembly to the left. When the solenoid is energized, Chamber A is exhausted and line pressure drives the piston to the right. Single solenoid type (illustrated) operates when solenoid is energized; returns automatically when de-energized.



Dual Solenoid (Bulletin 8344): operates when either solenoid is energized; will not return until opposite solenoid is energized (single solenoid types return when de-energized). In dual solenoid valves, solenoids may be energized continuously or momentarily.



J.I.C. Construction (Bulletin 8346) ASCO Single and Dual Solenoid Valves can be furnished to Joint Industry Conference requirements—valves are provided with subplates, vapor-proof solenoid enclosures, and manual overrides, and are electrically inoperative with the cover removed.

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